ENGINEERING LITERATURE

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Supplement to ENGINEERING NEWS — Thursday, May 14, 1903.

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There is an old idea, still held by some, that the writing of engineering treatises and text-books is logically the business of professors, editors and other kinds of "theorists"; and that the engineer engaged in the active exercise of his profession is either too busy, or else not sufficiently educated, to write good technical books. If there is any belief that has been exploded by the development of engineering in the last fifty years it is this one. The "theorist," from leading the profession, has come to follow it. Many a one, indeed, finds it necessary to hustle if he would keep up, and it is now the professor and the editor who are too busy to write books. But in case there be any among our readers who still look askance at the professional engineer in the role of author, their attention is called to some of the books reviewed in this and past numbers of the Engineering Literature Supplement. Many of the most notable of them were written by practical men, men who make a living in the field they write of, and who write well of their subject because they have lived with it.

In his review of the German work on "Gas, Gasoline and Oil Engines," elsewhere in this Supplement, Prof. Storm Bull draws the inference that because the German author pays so little attention to American gas engines we have been lagging behind in their design and construction. Be that as it may in this case, it is a notable fact that many books, particularly those written in England, practically ignore recent American practice. Take the subject of sewage purification, for instance: Your English writer generally refers to the investigations of the Massachusetts State Board of Health, but seldom makes references to any reports later than the special reports for 1900. In foreign technical writing, regardless of subject, it is rare indeed that the American engineering papers and society proceedings, with their vast stores of the most recent technical information, seem to have been examined. There are, we are pleased to say, exceptions to this overlooking or ignoring of American sources of information, and the exceptions appear to be on the increase.

Books on Mining.

A correspondent recently asked for a list of the best books pertaining to mining. It is presumable, when an inquiry of this kind is made, that the inquirer seeks first to gain a broad view of the art of mining, to which he may later add a detailed knowledge in so far as such knowledge can be had from reading.

While there are many excellent treatises in the English language on the art of mining, it is remarkable how few have been written by American engineers, and this is made more remarkable when we know that American mining engineers and mining men have developed many of the most ingenious labor-saving devices that the world has seen, such, for example, as the hydraulic "giant." But accepting conditions as we find them, we shall endeavor to briefly indicate what works may be read with greatest profit.

Standing easily first as a book from which a good general knowledge of mining may be obtained, is "A Manual of Mining" ($4), by Prof. M. C. Ihlseng, Dean of the School of Mines of the Pennsylvania State College. This book is an abbreviation of a course of lectures by the author From its opening chapter on veins and prospecting to its closing pages containing a glossary of mining terms and tables of useful information this work is admirable in its conception and execution. Methods of mining, hoisting machinery, underground and surface transporation, pumping and ventilation, and illumination are discussed in successive chapters of Part I., which takes up 323 pages of the book. Part II. is entitled "Practical Mining," and in its ten chapters and 200 pages are given detailed methods of shaft sinking, timbering, drifting and tunneling, stoping, boring and drilling, blasting, air compression and mine valuation.

To any one at all familiar with mining it is unnecessary to say that no single book of moderate size can contain all that it is essential to know about mining. And what is more to the point, no one man is capable of writing well on the details of every class of mining work. Professor Ihlseng has greatly added to the value of his work by citing, at the end of each chapter, a long list of references to articles in technical journals and in the Transactions of the American Institute of Mining Engineers. He might still further have increased the value of these references by summarizing the contents of each of these articles in a score or so of lines; and perhaps also by increasing the number of references somewhat.

Turning now to the English book, "A Text-Book of Ore and Stone Mining" ($10), by Prof. C. Le Neve Foster, we have a work parallel in scope with that of Professor Ihlseng. In our judgment it is not as good a book for American use as Ihlseng's "Manual of Mining." Furthermore, while it devotes some 550 pages to mining proper, the remaining 200 pages treat of ore dressing and milling, legislation affecting mines, the condition of the miner, etc. While at first sight it appears to contain more upon the subject of mining than any other single work, on careful examination this is seen not to be the case. Ore dressing comes, strictly speaking, under a heading entirely distinct from mining, and is in fact well treated in works on that particular subject.

Of hand-books for mining engineers, we know of but one that is at all satisfactory, and that one leaves much to be desired. We refer to the "Coal and Metal Miner's Pocket-Book" ($3), compiled by the editors of "Mines and Minerals." It treats, for the most part, of coal mining, although containing a great deal of general engineering information presented in clear and logical manner. Next to Professor Ihlseng's manual it is perhaps the most useful book of general information on mining, and can profitably be read by any student of mining.

The student having at least these two works giving the essential features and much detailed information, will next seek monographs on each subdivision of the art of mining. Here he will meet with discouraging results, for very little of this information exists in book form. "Ventilation of Mines" ($2.50), by J. T. Beard, is a good American monograph that may be studied with advantage. "Diamond Drilling for Gold and Other Minerals" ($5), by G. A. Denny, is another valuable monograph. "A Practical Treatise on Hydraulic Mining in California" ($5), by A. J. Bowie, and "A Text-Book of Coal Mining" ($7), by H. W. Hughes (English), complete the list of really meritorious monographs on mining. We are not now speaking of milling and metallurgical books, which will be considered later.

We thus see what a broad field is still left for American writers on mining. The subject of mine timbering alone is a large one, as yet inadequately treated by any writer. Of mine drainage the same may also be said. Even the well-worn subject of prospecting is very poorly treated by those who have written monographs on that topic. Mine examination or valuation is worthy of better treatment than it has received in monographs, and so we might go through the whole range of mining subdivisions. What we want now is not more ponderous manuals on mining in general, but more monographs written by men of experience in the subject upon which they write. An admirable illustration of what such a man can do is found in "Stamp Milling of Gold Ores" ($2.50), by T. A. Rickard; "Principles and Practice of Gold Milling" ($10), by C. G. W. Lock, also shows the "ear-marks" of originality. As before stated, we look in vain for many similarly written books on subjects pertaining to mining proper.

Perhaps it is the fear that later writers will "appropriate"—to use a smooth word for a harsh act—the subject matter of any good monograph, perhaps it is this fear that deters mining engineers in practice from writing such monographs as we should like to see. There is certainly no lack of knowledge either of the art of writing or of what to write, as a perusal of the Transactions of the American Institute of Mining Engineers will show. Whatever the cause for this dearth of books upon eminently practical subjects it is to be hoped that the cause, or the imaginary cause, will be removed. As showing that mere pressure of duties can hardly account for this aversion to writing, we may cite that recent ponderous work on "Diamond Mines of South Africa" ($10), by Gardner F. Williams, the present manager of the great Kimberly Mines. It is true that this particular work is not very technical, nevertheless it is exceedingly interesting and valuable, and it was not written in a night.

CORRESPONDENCE.

The Story of the Erie Railroad—A Correction.

Sir: On page 399 of Mr. E. H. Mott's historical account of the Erie R. R., which was reviewed in your issue of Dec. 18, 1902, in referring to the appointment of general ticket agent, it is stated that "up to 1846 there had been no general ticket agent, but one had now been provided in the person of Henry Fitch," etc. The fact is that Nelson A. Gurney was general ticket agent from the opening to Goshen in 1841 until Mr. Fitch's appointment. Mr. Gurney was a civil engineer and was transferred in 1846 to the upper Delaware Division at Deposit in charge of a ten-mile section of the relocation and construction. The

organization of the operating department of the Eastern Division during the first few years was: H. C. Seymour, Superintendent; S. S. Post, Master of Transportation in charge of the Freight Department; N. A. Gurney, General Ticket Agent in charge of the Passenger Department; Alex. Main, Cashier; B. S. Seymour, Superintendent of Way and Buildings in Rockland county; W. W. Morris, Superintendent of Way and Buildings in Orange county; John Brandt, Sr., Superintendent Motive Power; Pierre Van Rensselaer, Storekeeper; Jeremiah Van Rensselaer, Agent in New York; Silas Miller, Agent Piermont Pier. Wm. S. Sneden (the writer) was successively clerk in general ticket office, clerk of repair shops, way-bill clerk Piermont Pier, and also acted frequently as steamboat purser, and extra passenger conductor, joining the engineer corps at Deposit, April, 1848.

Many peculiar methods were adopted by the early ticket department to act as checks on the selling and using of tickets. The tickets sold at stations were used over and over until worn out—being returned from the general office. They were put up and used in packages of six different colors, no color being repeated during the week, and no similar color being duplicated on the same day of any succeeding week for a long time. A combination table was made out to regulate this, which was given only to the agents and conductors, and strictly kept from the knowledge of the public. This plan was supposed to prevent a passenger using a ticket over again which the conductor had failed to take up on the day purchased, as in most cases it would be of a color not in use on the subsequent day, and would be forfeited. Those methods were very crude and are amusing at this day, but it must be remembered that that was the experimental age in railroading, and that all evolution must have a basis to start from.

Wm. S. Sneden, C. E.

Red Bank, N. J., April 20, 1903.

Books on Blast Furnaces, Pumping Engines, and Gas Engines.

Sir: I wish to obtain the best and latest works on the following subjects, and therefore write you for as full particulars as you can give me regarding the books you recommend, together with their prices: (1) The design, operation and construction of blast furnaces. (2) The design and details of operation of air compressors and blowing engines for blast furnaces. (3) The design, operation, cost, etc., of water-works pumping engines. (4) The design and other details relating to mining pumping engines. (5) The design, space, speed, and cost of operation of large gas engines adopted for the use of the cheaper grades of gas. Yours truly,

F. W. Salmon, Assoc. M. Am. Soc. M. E.

Burlington, Ia., May 6, 1903.

(In "The Manufacture and Properties of Iron and Steel," by Harry Huse Campbell (New York, 1903; $5), there is a chapter of 77 pages on the blast furnace, which, with other information in the book, would presumably be of great service to our correspondent. Gas engines and gas producers are also treated briefly. The book was reviewed at length in the Supplement for March 19, 1903. There is no treatise on blowing engines, but much valuable information is given in manufacturers' catalogues, and there is a little on that subject in "Compressed Air and Its Applications," by Gardner D. Hiscock (New York, 1901; $5). An excellent German book on "Gas, Gasoline and Oil Engines" is reviewed elsewhere in this issue, and of several books, written some years ago by British authors. Robinson's "Gas and Petroleum Engines" has just been revised (London, 1902; 2 vols., $8.50). Two other British books are Bryan Donkin's "Gas, Oil and Air Engines" (London, 3 ed., 1900; $7; and Clerk's "Gas and Oil Engines" (London, rev. ed., 1899; $4). Barr's "Pumping Machinery" (Philadelphia, 1893; $5) was a good all-round book in its day. "Public Water Supplies" (New York, 1901; $5), by Prof. F. E. Turneaure, contains a good chapter on pumping machinery by Mr. D. W. Mead, with a bibliography including eight books and 36 references to periodical literature.—Ed.)

Is There a Good Book on Steel Ship Construction?

Sir: I am interested in the question of the construction of steel ships, and should like to get hold of all available literature on this subject. Can you or any of your readers inform me of such books? If there are none existing, what is the reason for their absence? It seems to me that the application of steel shapes to ship building is not much more recent than their use in other structural steel work. Yours very respectfully,

A. E.

New York, N. Y., May 6, 1903.

A German Treatise on Gas, Gasoline and Oil Engines.

Reviewed by Prof. Storm Bull,* M. Am. Soc. M. E.

DAS ENTWERFEN UND BERECHNEN DER VERBRENNUNGSMOTOREN.—Handbuch für Konstrukteure und Erbauer von Gas- und Oilkraftmaschinen. Von Hugo Guldner, Oberingenieur Gerichtlicht vereideter Sachverständiger für Motorenbau. Berlin: Julius Springer. Cloth; 8 x 11 ins.; pp. 546; 12 tables and 750 figures in the text. $6.

It does not seem that there can be any question but that the above book is the best reference work on gas, gasoline and oil engines which has yet been published in English, German or French. As the author points out in the preface, the almost innumerable books on gas engines published during the last ten years or so have all sacrificed the practical considerations to theoretical ones. At the most these books have given a number of pictures of engines, not provided with dimensions, or drawn to any scale, so that the designer of gas engines could profit but very little from the descriptions. In the present instance the author has set out to produce a work which was to be of the greatest help to the designer and builder of these engines, and in this, it seems to the reviewer, he has admirably succeeded. He has divided the work in five parts. The first part contains a critical description of all the important gas, gasoline and oil engines which have been designed so far. It is of course unnecessary to state that only engines in which something really new had been introduced have been considered in detail. The illustrations have all been made especially for this book and are remarkably clear and are nearly all provided with dimensions. An American cannot but help noticing that it has seemed unnecessary to the author to describe but very few American engines. Although we all know that we have been lagging behind Europe in this branch, yet it is rather humiliating to find that we have counted for so very little; at least, in the eyes of a thoroughly competent foreigner. Wherever it has been possible the economical results of accurate tests have been given for the various engines, and to anyone who reads this part carefully it is easy to see not alone how and why the enormous progress in the efficiency of these motors have been made, but also in which direction further progress may be hoped for.

The second part contains an examination of the working methods and of the various cycles of these "combustion motors," as the Germans call them. The author treats here necessarily, also, of the various efficiencies which can be expected or which have been reached with the various cycles, as also with varying degrees of compression. He concludes this chapter with a comparison between the two and four-stroke cycle engines. He states that the efficiency of these two classes of engines is about the same at the present time; that the first cost of the former is considerably lower for large units, and that consequently there is no doubt in his mind that at least for large units the future belongs to the two-stroke cycle engine.

In the third and probably most important section, which is also the longest, the author deduces rules and formulae for the design of all the more important parts of the engine. These formulae are all of a rational nature and the subject is treated in such a thorough manner that it is really surprising when one considers that it is almost a new field. This part contains also a very large number of working drawings of the several parts of the engines of various, but only modern, makes, and these designs are all critically described in connection with the rules given. The author points out that there is a very much greater necessity for carefully computing the various parts of a gas engine than for doing the same for a steam engine, and this especially in view of the very high pressures and temperatures used in the modern gas engine. It is almost unnecessary to state that this third part ought to be an invaluable aid to all designers of such engines.

The fourth part contains plans and descriptions of a number of complete installations, among them several for the use of blast furnace gas. The drawings and illustrations are also here of the same excellent character, and they are accompanied with tables giving weights, measures and also efficiency obtained. The last part of this chapter treats of the engines used for automobiles and other vehicles.

The last section treats of the fuels used, and of their combustion. The treatment here, also, is thoroughly rational, and it is evident that the author is perfectly familiar with all experiments which have been carried out in this branch of the subject. This part will be valuable to both the designer and user of these engines, and although the material is not new to any great extent anyway, yet the reviewer does not know of any book besides this in which to look for all of this information. This section is also notable for its conciseness.

The author has added a chapter on thermodynamics and on thermo-chemistry, in order to help those technical men who are not familiar with these subjects, so that they also might use the book.

The publishers have done everything in their power to make the book attractive. Print, paper and illustrations are excellent, and it seems a wonder that a book of this size and character can be sold for $6. If published in this country it does not seem probable that it could be sold for less than $10.

It is the opinion of the reviewer that somebody could do the gas engine industry and the technical world in general in this country a great service by translating the book. It would involve an enormous amount of work, as the innumerable tables would all have to be changed from metrical weights and measures to the corresponding English ones. But with the present progress in this industry in the United States it would seem a pity if such a book as this should remain unknown to most of those interested in the subject, as will be inevitably the case if it is not translated.

*Professor of Steam Engineering, University of Wisconsin, Madison, Wis.

THE GAS ENGINE HAND-BOOK.—A Manual of Useful Information for the Designer and the Engineer. By E. W. Roberts, M. E. Fourth Edition, Revised and Enlarged. Cincinnati, O.: The Gas Engine Publishing Co. Leather; 4 x 5 ins.; pp. 264; 40 illustrations in the text. $1.50.

The first and second editions of this practical little book appeared in 1900. The latter, which included some new matter, was favorably noticed in Engineering News for April 18, 1901. The principal change in the present edition is the addition of some 20 pages on automobile engines, and the revision of the section on screw propellers.

THE PRINCIPAL SPECIES OF WOOD.—Their Characteristic Properties. By Charles Henry Snow, M. Am. Soc. C. E., Dean of the School of Applied Science, New York University. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 7 x 10 ins.; pp. 203; 39 full-page half-tones, and figures in the text. $3.50.

Professor Snow states in his preface that this book is for those "who are not foresters or botanists, but who use woods or desire knowledge of their distinguishing properties." The author's plan includes a general description of each genus and a particular account of each species that is of any importance in construction, decoration and furniture, in manufacture of implements and materials or for its by-products. The particulars given for each species are its popular nomenclature, the locality in which it is found, the general features of the tree, the color, appearance and grain of the wood, the structural qualities of the wood, the representative uses of the wood, the weight of the seasoned wood in lbs. per cu. ft., its modulus of elasticity and modulus of rupture, and some general remarks. Each description of a species occupies a page and, as there is almost invariably some unused space, the book might have been made more useful to the student if these remarks and the notes on the features of the trees had been expanded so as to aid in distinguishing the living trees. The half-tone illustrations are generally excellent, particularly those showing the trunks of trees and cross-sections of the wood; those which show the characteristics of leaves, fruit or flowers would have been better if made direct from good photographs instead of from wash drawings.

A New and Valuable Book on Wire Ropes.

Reviewed by Wilhelm Hildenbrand,* M. Am. Soc. C. E.

DIE DRAHTSEILE.—Everything Necessary for Correctly Judging, Constructing and Calculating Wire Ropes. By Joseph Hrabák, Professor at the Mining Academy of Pribram, Hungary. Berlin: Julius Springer. Cloth; 6 × 9 ins.; pp. 220; 14 plates, and 72 illustrations in the text.

This new book on "Wire Ropes" will undoubtedly be received by the engineering profession with great interest. Manufacturers, as well as consumers of wire ropes and engineers using wire ropes in structural work, will find a great deal of instruction and many useful hints which will amply repay them for the trouble of studying Professor Hrabák's unique treatise on a subject which, so far, has unreasonably been neglected in the technical literature. The author hits the mark when he says in his introduction:

> In all the technical arts there is hardly an object as often and as manifoldly used, and at the same time as little understood or as little subjected to study, as wire ropes are!

With the intention of filling this vacancy in technical knowledge, Professor Hrabák has tried to tell, in a clear and easily comprehensive style, all about the nature and the application of wire ropes. To this end he has drawn upon both his own knowledge and studies, and the practical experience of manufacturers and mine workers.

The first chapter gives a short sketch of the history of wire ropes. We learn that wire ropes were invented by Albert, Chief Engineer of the government mines at Clausthal, Hanover, and that in 1834 the first wire ropes were introduced in several mines of the Hartz Mountains. In the same year the firm Felten & Guilleaume, of Mühlheim-on-the-Rhine, began regularly to manufacture and sell wire ropes. The first wire ropes were twisted by hand, but already in 1837 hand work was superseded by a rope twisting machine, invented by Wurm of Vienna. On the Wurm machine the twisting of wires to strands, and of several strands to a rope, was done in one operation, but it was soon found to be more practical to separate the two operations and to use special strand machines and separate rope machines. Most modern machines are of the latter kind, but in general principle they do not differ much from the original Wurm machine. At first, the twist of the strands and that of the rope was in the same direction, known as the "Albert lay," but in 1840 these twists were made in opposite directions, called "cross lay," with the object of checking the disagreeable rotary motion of hoisting ropes made with the "Albert lay." The latter ropes were entirely abandoned for about 40 years, when they were taken up again on account of some advantages at certain applications; and this original, for years antiquated "Albert lay" was finally patented in England and much advertised under the name of "Lang ropes"!

In the second chapter the author describes different kinds of wire ropes, dividing them into three classes:

1. Once twisted, or "spiral" ropes, consisting of a number of single wires twisted around a heart of hemp.

2. Twice twisted, or "regular" ropes, consisting of a number of spiral ropes or "strands" (generally 6) laid around a hemp center.

3. Thrice twisted, or "cable" ropes, consisting of a number of regular ropes twisted around a center strand of hemp or wire.

Before 1870 most wire ropes were made of iron wire, having an ultimate strength of 71,000 to 85,000 lbs. per sq. in. Since then, great progress has been made in manufacturing ropes of steel wire, their ultimate strength now varying from 170,000 to 355,000 lbs. per sq. in. First-class steel wire, fully reliable for the use in wire ropes, has a strength of 256,000 lbs. per sq. in. The modulus of elasticity, as given by the author, varies from 25,600,000 for soft steel to 28,400,000 lbs. for the hardest steel.

The third chapter, describing old and modern rope-twisting machines and the different methods for "laying up" ropes will be more interesting to specialists than to the general public. In the three following chapters a number of useful tables will be found, in which the author gives the aggregate area of all wires in a strand or rope, for a great variety of differently constructed ropes. He also gives a theory, expressed in formulas, for finding the diameter of a rope from the number and diameter of the single wires and from the twisting angle. The author finds that, if d denotes the diameter of the rope, δ the diameter of one wire, the following proportions are very nearly correct:

$d = 3\ \delta$ for spiral ropes of 6 wires;
$d = 9\ \delta$ for regular ropes of 36 "
$d = 27\ \delta$ for cable ropes of 216 "

There are tables, however, giving the exact diameter of ropes composed of different numbers and different sizes of wire.

In the sixth chapter the author illustrates about 60 sections of differently composed "spiral," "regular," "cable," "flat" and "locked" wire ropes. Of these sections he recommends especially the so-called "strand spiral rope," proposed by himself for the "rope of the future." It consists of strands, varying in number from 9 to 38, laid around a center core, in one, two, or three concentric rings.

The seventh chapter is devoted to the theory of wire ropes, especially to the bending stresses of ropes working over pulleys or drums. The author starts with Reuleaux's formula:

$$\sigma = 0.5\ E_0 \frac{\delta}{R},$$

in which σ denotes the bending stress per sq. in.

E_0 = the modulus of elasticity of wire;
δ = the diameter of a single wire;
R = the radius of the pulley around which the rope is bent.

Professor Hrabák considers the value of σ, obtained from this formula, too large, if E_0 is the modulus of elasticity of wire, or too small if, as has been attempted, for E the modulus of elasticity of the rope be substituted. He says:

> We know of bending stresses in wire, but not in ropes, hence Reuleaux's formula can only give correct results, if the modulus of elasticity *of the wire in the rope* be introduced in the formula.

The modulus of elasticity of ropes (E, E_1), according to extensive tests made by Prof. C. Bach, has the following relation to the modulus of elasticity of wire:

$E_1 = 0.6\ E_0$ for once-twisted ropes;
$E_1 = 0.6^2\ E_0$ for twice-twisted ropes;
$E_1 = 0.6^3\ E_0$ for thrice-twisted ropes.

From original formulas, derived by the author, in which E_0, E, E_1, and the twisting angle are factors, he finds the modulus of elasticity (E) of wire in the rope to be as follows:

$E = 0.66\ E_0$ for once-twisted ropes;
$E = 0.44\ E_0$ for twice-twisted ropes;
$E = 0.29\ E_0$ for thrice-twisted ropes.

These are, of course, average values corresponding to the average customary twisting angle.

In the eighth chapter the results of the calculations in the previous chapter are tabulated, and the practical application of the formulas and tables is shown on several examples of more and less pliable ropes for transmission or hoisting purposes.

Very interesting is the ninth chapter, in which the author considers very thoroughly the often disputed, and never decided, question whether wire centers in strands and ropes are of advantage or disadvantage. The author is of the opinion that wire centers are irrational and should in all cases be avoided. He comes to this conclusion by calculating that the wire center, owing to the relative extension of all wires, must carry 62½% of the whole load, hence is theoretically bound to break before the other wires have received their normal tension. He also shows that the modulus of elasticity of a strand with wire center is 1.6 times the modulus of the wire, hence such a strand is 37½% less ductile than the wire alone would be. The modulus of elasticity of a twice-twisted rope with wire center is 0.96 E_0 or about equal to the modulus of the wire itself. The author concludes his criticisms on wire centers with the severe remark that the only advantage of ropes with wire centers is on the side of the manufacturer who receives for a smaller outlay of labor and a poorer product more money.

The tenth chapter treats exclusively the qualities of "Patent locked" ropes. The author considers it an error to use such ropes for cable roads, for which purpose they were principally advertised in America, but he thinks they are, owing to their small elongation, excellent for cables of suspension bridges. In the eleventh chapter a number of tests on the elongation, respecting the modulation of elasticity, of wire ropes in operation are recorded and tabulated. It was found that the modulus of elasticity of new ropes is only half of what it will be after a rope has been in use for some time. At first the modulus increases rapidly, then slower, then remains stationary and finally is getting smaller again. The latter case is called by the author the "memento mori" for the rope, because the diminution of the modulus is only seeming but not real. The modulus is the same as before, but the larger elongation is due to a reduction of area of the rope, hence a warning that the rope has overstepped the danger point and should be removed.

In the final chapter the author gives formulas and valuable information for the calculation of hoisting ropes in deep shafts and for the proper diameter of hoisting drums. He comes to the conclusion that cylindrical ropes are best for all depths down to 2,500 ft., but that beyond that depth tapered ropes may be used with advantage. In regard to the radius of hoisting drums he gives the scientifically tested, empirical rule:

$$R = 850\ \delta, \text{ or } R = 85\ d,$$

when δ denotes the diameter of a wire and d that of the rope. A number of plates attached to the book, representing sketches and pictures of rope-making machines, and photographs of different kinds of wire ropes, will be found interesting and instructive.

In reviewing Professor Hrabák's book, the writer was disappointed in not having found any data in regard to the limit of elasticity of steel wire, which is an important factor in judging the proper application and working stress in wire or wire ropes. American testing experts have found that the limit of elasticity of high grade steel wire is 1½ to 1¾ times larger than that of steel, in other forms, expressed in percentage of the ultimate strength. (In absolute figures the elastic limit of steel wire is five times larger than that of the best structural steel. This quality of steel wire is very important for determining the safety factor, hence the size and quality, of wire ropes for different applications. It is to be regretted that the author of the book did not devote a separate chapter to this point. Professor Hrabák was probably also not aware that some of the rope sections proposed by him as "ropes of the future" have already been manufactured in America and are known under the name of "hawsers." As far as the writer of this review knows, Professor Hrabák's book is otherwise the most complete ever written on the subject, and it can be recommended to students of engineering as well as to manufacturers and consumers of wire ropes.

SUPPLEMENT TO THE DIRECTORY OF THE IRON AND STEEL WORKS of the United States.—Containing a Classified List of Leading Consumers of Iron and Steel in the United States. Compiled by the American Iron & Steel Association. Corrected to January, 1903. Philadelphia: The American Iron & Steel Association. Cloth; 6 × 9 ins.; pp. 196. $5.

As the title implies, this directory is a supplementary one. Nevertheless it contains the names, addresses and output of a great number of plants, as might be inferred from the 196 pages of text. As to contents we can do no better than to quote from the preface:

> The Supplement contains practically complete lists of the following leading consumers of iron and steel: Iron and steel bridge building works; iron and steel shipbuilding plants; locomotive works; all kinds of car-building works; car-wheel works; car and locomotive axle works, and steel locomotive tire works; chain works; cast-iron pipe works; wrought iron and wrought steel pipe and tube works; riveted pipe works and seamless-drawn tube works; wire, wire-nail, cut-nail and horse-nail works; works for the manufacture of cold-rolled, cold-drawn, turned, polished and ground shafting; stamping and metal ceiling works; malleable iron works; bolt, nut and rivet works; and works for the production of all kinds of forgings, including drop forgings. Some of these lists are entirely new, never having appeared in the Directory.

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Mine Ventilation.

VENTILATION IN MINES.—By Robert Wabner, Mining Engineer. Translated from the German by Charles Salter. London: Scott, Greenwood & Co. New York: D. Van Nostrand Co. Cloth: 7 × 10 ins.; pp. 240; 30 plates, and 22 illustrations in the text. $4.50 net.

This volume is a valuable addition to the literature of mine ventilation. It is clearly and scientifically written. The chemical and physiological actions of mine gases, CO in particular, are presented in a manner that merits especial praise. Ordinarily we find that all gases have looked alike to writers of works on ventilation. Here we find intelligent discrimination. In the first chapter, on the causes of air contamination, not only are the various gases and their effects discussed, but the treatment of miners suffering from partial asphyxiation is also considered. In the next chapter dust explosions and their prevention, and precautions for preventing explosions at times of blasting are discussed; following which are described the methods of rescuing miners, the various helmets and devices used for that purpose being illustrated.

The third chapter treats of the calculation of the volume of air needed to keep the mine atmosphere pure; and devices for measuring air velocity are shown. In the chapter that follows formulas for the frictional resistance of air are given and examples showing the application of the formulas are solved. In the fifth chapter ventilation by natural draft, and by furnace heat is well handled. The efficiency of fuel when thus used is demonstrated by a number of good examples. In dry, deep shafts the calorific power of 80% of the fuel may be used in doing useful work, while in narrow, wet shafts the efficiency falls to 20%, according to experiments cited by the author.

Mechanical ventilation is given three chapters, and there is an admirably lucid exposition of the efficiency of compressed air when used in an injector as compared with its direct escape. Electricity as a fan motive power is given brief space; but the various types of fans, especially those used abroad, are illustrated and described quite fully; and a number of problems are solved to show how to calculate the dimensions of fans. The advantages and disadvantages of operating fans by suction and by blowing are briefly reviewed.

In the last two chapters the author discusses the means and methods of handling the air currents, by "air dams," "brattices," "air tubbing" and the various well-known devices for this purpose. A few more illustrations and practical examples of the details of construction would have added to the value of these two chapters.

The book as a whole is one that any engineer or student confronted by problems of mine ventilation may consult with advantage, for it is neither so elementary as to be barren of data desired by the engineer, nor so profound as to be unintelligible to the practical man.

SILICO-CALCAREOUS SANDSTONES.—Building Stones from Quartz and Lime. Chemical and Technical Principles of Their Manufacture According to the Situation, Erection and Management of Brick Works. By Ernst Stöffler. New York: Spon & Chamberlain. London: E. & F. N. Spon. Paper, 6 × 9 ins.; pp. 36; illustrated. $1.

This book describes the technology of lime-sand brick manufacture as practiced in Germany where the industry has reached considerable dimensions. As many of our readers know, a number of concerns in the United States are now manufacturing lime-sand bricks under various German patents, and others are about to build factories and commence manufacture. These products are, therefore, certain to be brought to the attention of engineers and builders as time goes on, and it will perhaps pay engineers to examine the literature concerning their manufacture and character. The book before us is a somewhat general discussion of principles and methods, but it gives, on the whole, about all that the user of lime-sand brick is likely to wish concerning methods of manufacture. It lacks in data regarding the physical and chemical characteristics of this material, but something of these will be found in an article published in Engineering News of Jan 22, 1903.

Translation of a French Book on Induction Motors.

Reviewed by Prof. Henry. H. Norris.*

THE INDUCTION MOTOR.—Its Theory and Design Set Forth by a Practical Method of Calculation. By Henri Boy de la Tour, Chief Electrician and Designer, Electrical Department of the Compagnie Fives-Lille, Givors, France. Translated by C. O. Mailloux, M. Am. Inst. E. E., M. Inst. E. E. New York: McGraw Publishing Co. Cloth; 6 × 9 ins.; pp. 200; 75 illustrations. $2.50.

A very excellent text-book for advanced electrical engineering students is found in the translation of this work. The treatment will be appreciated by all users of induction motors who are interested in learning the principles of operation of this increasingly useful machine. No other machine will repay study like this one, for in it are combined the elements of almost all others. The transformer is present as well as the motor, while as a producer of counter-electromotive force the action of a generator is also exemplified. The wonderful manner in which the short-circuited or "squirrel-cage" secondary supplements with its own the primary magnetomotive force is intensely interesting. For these reasons it is an excellent machine for students to design merely for the thorough training in electrical principles which it will give them. At the present time the manufacture of induction motors is limited to the fortunate companies holding patent rights. In due time, however, these will expire, and then, no doubt, the manufacture will be general and the demand will increase with the reduction in prices which will be brought about by competition. Aside from the theoretical worth of this machine, its commercial development has been rapid, and at the present time it is the close competitor of the direct-current motor in almost all fields. Freedom from sparking, high rotative speed allowable, economy in transmission and simplicity of construction must in time make this the main device for transformation from electrical into mechanical power.

The translator, who is an engineer of long experience and exceptional ability, is well fitted to introduce this work to American readers. He has supplied an introduction in which are explained certain terms which are often used ambiguously. This adds greatly to the value of the work by putting the author and his reader, separated as they are by language and by engineering customs, into touch with each other. The introduction also contains a list of symbols, which is an essential feature in a treatise containing so many formulae covering such a wide range of phenomena. The book is short and at the same time the explanations are clear. The method of treatment is graphical in form and every step taken is introduced by a brief explanatory statement.

In the first chapter, which is devoted to the rotating field, the author does not resort to the usual devices for approaching the matter gradually, but assumes at the outset a cylindrical arrangement of conductors carrying polyphase currents. With the aid of a four-pole model, which is discussed and clearly illustrated, the actual form of distribution of magnetomotive force is calculated and charted. On account of the low magnetic density used in induction motors the reluctance of the iron parts of the circuit can be safely neglected, so that the flux density becomes proportional to the magnetomotive force. With a definite number of conductors and a small number of phases the distribution of the flux varies from time to time, the total amount of flux per pole remaining approximately constant. By assuming a number of values for the currents, the equivalent sine-form distribution of flux can be determined with fair accuracy. On pp. 16, 17, 21 and 22 are given tables of the constants connecting the polyphase magnetomotive forces and the maximum values of the sine-form flux densities. This table will be found very useful in making induction motor calculations. The progression of the flux is clearly shown, as the distribution is charted for successive values of the current, the speed of this progression being one pair of polar intervals per cycle per second of the magnetomotive force. In this chapter the various windings are described, with constants for each variety.

As the field progresses the flux cuts the conductors, inducing electromotive force therein in proportion both to the velocity and to the density of the flux. The distribution of the flux density having been determined in accordance with the method given above, it becomes possible to calculate also the distribution of the electromotive forces in the conductors, and by adding together those of the conductors in series, to determine the total electromotive force at any instant. This is worked out in a simple manner for several cases, and remarkably concise formulae are deduced and constants prepared for all commercial numbers of slots per coil.

Next in order of interest after the electromotive force calculation is the manner in which the torque is produced by the interaction of the current in the moving conductors and the flux in the field. The flux distribution is known, as is also that of the currents, for if the resistance of the motor windings is given the current in any circuit will be simply the electromotive force divided by the resistance. This assumes no inductance due to magnetic leakage, in the secondary winding, which cannot be realized in practice. The author shows how to allow for this in a simple manner.

It is evident that the magnetomotive forces of the secondary winding modify the flux produced by the primary. The secondary magnetomotive force distribution is of the sine form, displaced somewhat in phase position from that of the primary. The sum of primary and secondary distributions produces, therefore, a third magnetomotive force of a sine form also. This is the real cause of the flux, and in Chap. IV. the author treats this feature for the various commercial windings.

Probably the most difficult design feature of this class of machines is the predetermination of the resistance of the "squirrel-cage" secondary. As all of the conductors are short-circuited by the end rings, a peculiar disposition of currents results and the application of Ohm's law becomes intricate. The chapter given to this subject will, therefore, be read with much interest. The author deduces simple formulae for calculating the current distribution and the heat losses in these secondaries.

A convenient feature which increases the value of the book as a reference work is a summary of the results of the analysis, so arranged that the designer has at hand in small space the formulae and constants previously deduced. This closes the design section of the book, with the exception of some examples of design and performance numerically worked out in a later chapter.

Users of induction motors will appreciate the excellent material treating of induction motor performance. By the application of vector diagrams to a numerical case, the values and phase relations of all the quantities involved in the operation of the motor are worked out. These calculations cover all losses, speed regulation and torque production. The simple vector diagram requires a separate calculation for each value of slip, so that the author includes and explains the system of circle diagrams for more completely analyzing the motor performance. The practical value of the thoretical matter of the book is made clear by means of some actual cases, which are thoroughly studied.

The American edition is enriched by a new chapter describing and discussing the action of the Heyland motor, which operates with a power factor of unity. As one of the chief objections to the ordinary induction motor is the low power factor, with all of the consequent ill effects, the widespread interest in this motor is readily understood. The result is produced by the introduction of a current into the secondary winding, which modifies the field by producing a synchronously rotating magnetomotive force. The phase relation of this to the impressed magnetomotive force is such as to bring the flux into quadrature with the total primary current. This desirable result has, however, been obtained only by greatly complicating the construction through the addition of commutator and brushes. Aside from commercial considerations the motor is highly instructive and this chapter rounds out and fitly closes what we regard as a most excellent treatise. It is interest-

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ing, but completeness is not sacrificed in order to produce a readable style. The translator has added to the original worth of the work by his clear explanations, and he has chosen his words with the combined purposes of having the English read smoothly and at the same time preserving the spirit in which the original was written.

Storage Battery Engineering

STORAGE BATTERY ENGINEERING.—By **Lamar Lyndon**, B. E., M. E., Assoc. M. Am. Inst. E. E. New York: McGraw Publishing Co. Cloth; 6 × 9 ins.; pp. 382; plates, and 177 figures in the text. $3.

Storage battery practice, as a separate branch of the electrical engineer's art, has never been summarized in a treatise until the appearance of the present work. The accumulator or secondary cell is a complex affair; as a voltaic or electrochemical cell it is in a large degree not yet understood, while as an engineering appliance it is usually a vexation. Theoretically, there are many kinds of secondary cells, and this fact has, ever since the first beginnings of storage batteries, kept inventors and discoverers at work seeking for a combination of electrodes and electrolyte that would meet all requirements of practice. They have very regularly failed in accomplishing this object, and it is still true (and likely to remain true for a long time to come) that storage battery is synonymous with lead-lead peroxide secondary cell. But of the lead cell itself we know little more than of the other secondary cells which are theoretical possibilities. The chemical changes going on during charge and discharge have been studied by many investigators without giving us any certain and positive knowledge. It is not especially important for the electrical engineer to know these reactions and changes merely because they occur; but they are responsible for the peculiar and far from ideal action of the cell. In strict theory, a secondary cell should be charged by an impressed voltage of uniform value up to a definite point at which the action ends; on discharge the cell should be able to give a definite and constant potential, of slightly lower value than the charging voltage, up to a certain point at which the cell has given up all its available energy. The electrodes or elements should be permanent in character, going through cycles of change which repeat themselves identically, without material change or deterioration of the active elements. The actual facts are quite different. The point of full charge is by no means definite, while an entirely arbitrary point has been assumed for full discharge, even though much electrical energy might still be gotten out of the cell. The voltage across the cell, instead of remaining constant during charge or discharge, shows very large variations, from 2.5 down to 1.8 volts (which is the limit which has been fixed as the end of discharge), and would vary even more if the discharge were carried farther. The elements of the cell are in constant process of change, or deterioration. Various kinds of "diseases" attack them, and constant watch is necessary to detect unfavorable symptoms in time to remedy the failing.

It is clear that there is a large field for storage battery engineering, that is to say, for the exercise of practical skill in turning to good and reliable use such an imperfect appliance as the lead cell. Many of the difficulties in such application are met by proper design or construction, while others require proper methods of operation, only to be deduced from practical study and experience. It is the province of the book under consideration to show the types of construction which have proved successful, and to outline the accessory appliances and the methods of operation which have been devised to make the best practical application of storage batteries. Having thus an eminently "engineering" purpose, the book appeals to a large circle of readers.

The author's practical aim and strict adherence to his subject is evident on the first page of the book:

> There are many (voltaic) couples which . . . can be used as storage batteries, but, with the exception of lead peroxide against lead and lead peroxide against zinc, none so far has proven commercially available for engineering purposes. . . . The lead-lead cell being in general use—practically to the exclusion of all other types—it only will be considered in detail here.

He reviews in the first chapter very briefly the facts that have been learned as to the chemical changes in the cell and in Chap. III. describes how the voltage across the cell varies with the state of charge, the temperature, etc. As already suggested, the variation in voltage is a highly important matter; an almost equally important factor in the application of the cell, its capacity (in ampere-hours) is no more constant than is the voltage, though the causes of its variation are quite different. In a properly designed cell the main factor affecting the capacity is the rate at which current is drawn from the cell; the faster the discharge, the less the total ampere hours which the cell will yield. Capacity variation is discussed in Chap. IX. Both capacity and voltage are affected by the temperature at which the cell is worked; Chap. VIII. gives curves and other information in regard to this effect. Intercalated between this and the chapter on voltage variation is a summary of information about the quantity and weight of active electrode material and the nature and quantity of the electrolyte necessary for a desired capacity; some remarks are also given on the effect of impurities in producing "internal discharge" of the cell, which, since it is a recurring pure loss, must not be permitted to occur. A storage cell has its own proper resistance, like any other conductor of current; not all of this is simple ohmic resistance, however, for a certain amount of energy is lost in irreversible chemical processes, while the opposing potential of the cell on charging enters as a resistance. In Chap. X. are given average figures for the pressure drop due to resistance, in commercial cells, at different rates of discharge or current flow. (Tests of cells are advisable to determine the resistance; they are discussed later in the book.) This internal resistance, together with the average voltage difference during charge and discharge, and some other factors, combine to make the energy-efficiency of a storage cell rather low (ordinarily about 80%); but for various obscure reasons it has become customary to judge batteries according to their capacity-efficiency, which is the discharge in ampere-hours divided by the charge. This is nearly always a high figure, while the variation in voltage brings the watt-hour efficiency much lower. However, the efficiency of a storage battery is hardly a definite thing, since the points of charge and discharge are indefinite and the rate of current-flow affects all the factors of the question. Besides, there is still a third kind of efficiency, that which is concerned with life or durability, and with maintenance charges, which may be more important than the other two. But it is even more indefinite, since it depends to such a large degree on careful handling, and, further, is apt to vary greatly with identical cells under identical conditions. In Chap. XII. the author discusses a number of factors in the construction and the handling of the cell which affect its deterioration, while under "Diseases and Their Remedies" and "Care and Management," he gives many valuable suggestions and instructions toward maintaining the battery in best condition.

The history of the storage battery is scarred with patents. The press of inventors working on substitutes for the lead battery have been referred to, and it has been stated that their efforts were productive of little good. The lead cell itself has been the working subject of an equal number of inventors. Planté and Faure are the two big names connected with the lead cell. The former invented the lead storage battery, and his name is used to denote a cell having lead electrodes which by alternate charging and discharging are converted into serviceable battery plates. Faure first made (though others had before used them) good plates which did not require this slow conversion or "forming," by applying the active electrode material, chemically produced in finished form, to the surface of a supporting and conducting lead electrode; the principle was patented in America by Brush, whose rights expired only a few weeks ago. Both of the basic processes were elaborated by numerous other inventors. A flat lead plate is not the best for the Planté process, since other shapes give much larger exposed surface with equal strength; again, the simple forming process is greatly accelerated by the use of various chemicals. With the use of the Faure principle, a great variation is evidently possible in the shape of and manner of making the lead part of the electrode, the "grid," as it is called, and also in the composition of the active material mixture. Chapters XV. to XVIII. give a quite full summary of the processes, mixtures and designs which have been commercially used for making Planté and Faure plates. It is usually desirable to encase battery plates in enveloping cases of porous material, to prevent loose pieces from falling off, and it is essential that adjacent plates be held apart by separators. These purely mechanical details are described in Chap. XIX., while a related matter, the containing vessel of the battery, is discussed in Chap. XX. Passing then from the consideration of the batteries, the author takes up the details of their mounting and installation, conductor bars and connectors, battery stands, etc. These details require special attention and protection because storage batteries give off acid fumes, which corrode most metals and destroy contacts at connections. The testing of batteries, next discussed, involves many items. Voltage tests during charge and discharge are made separately from each electrode to the electrolyte, or rather to a cadmium test-piece. The capacity and proper current flow per square inch should be determined, the standard capacity being measured at such a rate of discharge that the voltage falls to 1.8 volts at the end of eight hours (8-hour rate). Various methods for measuring internal resistance are given, and an apparatus is shown for approximately testing the durability of a cell by 150 cycles of charge and discharge at the three-hour rate.

In Part II., the second half of the book, the appliances and methods of operation are considered which are required to commercially apply storage batteries in stationary plants. Of course, many cells in series are always necessary in order to obtain the desired voltage (one cell giving from 1.8 to 2.3 volts). The voltage variation usually must not affect the circuit supplied, but must be compensated. Counter e. m. f. cells, which act merely to cut down the voltage of the battery, or end cells, which are active cells arranged so they can be added to the series, are used for this compensation, being connected up with an end-cell switch, which enables them to be cut in or out of the circuit for getting just the desired voltage. (Sometimes in small plants adjustable resistances may be used in circuit. A carbon pile resistance is shown for this purpose.) End-cell switches, both hand-operated and automatic, are fully described with proper attention to the peculiar points in which they differ from ordinary switches. Indicators for showing the position of an end-cell switch at a distant point, e. g., in the switchboard room, are referred to, as is also the proper arrangement of end-cell conductors—usually a large item of expense on account of the many large copper bars required.

Another method of regulating voltage is by means of boosters—dynamos which either raise the voltage of the battery current by the amount necessary to give constant potential in the outside circuit, or raise the generator voltage enough to enable it to supply a battery which later works in parallel with the generator. For different purposes these boosters are either shunt, series, compound or separately excited machines. The various arrangements are fully described and the methods of calculating the booster given. Some booster systems require regulating rheostats, which must be of special construction; several types of such rheostats are described, and in connection with this are some remarks on circuit breakers for boosters and batteries. Following this, the methods of connecting batteries, or batteries with boosters, on two-wire and three-wire systems are described, with a short chapter on the special arrangements required to apply batteries to alternating-current systems.

The size of the battery required for any given purpose is then discussed, the special case of a line battery used to hold up the current at the end of a long line (as a railway line) being separately treated. The author then shows how to calculate the efficiency of a plant having a battery; he points out how the steadying of load by

the battery may result in saving. In the final chapter, the application of a storage battery to a small isolated plant, as an apartment house, is worked out, with an approximate computation of cost.

It will be seen from the preceding sketch of its contents that the book takes a practical ground throughout. It should be equally valuable to the practicing engineer and to the student. It is to be noted that all discussion of portable batteries is omitted.

Translation of an Abstruse German Work on Evaporating and Allied Apparatus.

EVAPORATING, CONDENSING AND COOLING APPARATUS.—Explanations, Formulas, and Tables for Use in Practice. By E. Hausbrand, Chief Engineer for C. Heckmann, Berlin. Translated from the Second, Revised German Edition by A. C. Wright. London: Scott, Greenwood & Co. New York: D. Van Nostrand Co. Cloth; 6 × 9 ins.; pp. 400; 76 tables, and 21 illustrations in the text. $5 net.

If an engineer or a student wishes to post himself on the subject of the capacity and efficiency of different kinds of evaporating, condensing or cooling apparatus there are two plans which he may pursue. The first is to collect from all available sources information concerning the work of apparatus actually in service or for sale by builders; this will include the information given in manufacturers' catalogues and the reports of tests found in the transactions of engineering societies and elsewhere. From the data thus obtained he may compile tables and plot curves, and finally arrive at some empirical laws and formulae which he may use in designing. The second method is to begin with the theoretical laws of heat transmission and with the results of experiments in physical laboratories, collecting from published papers the coefficients, more or less variable, which must be inserted in the formulae. An example of the first method is the computation of the heating surface of a steam boiler, the most common form of evaporating apparatus. By numerous experiments it has been learned that the maximum commercial economy of a steam boiler is obtained when it is driven at such a rate that 3 lbs. of water are evaporated into steam per hour for each square foot of heating surface. Knowing then the number of pounds of steam required per hour, we simply divide that number by three to obtain the heating surface in square feet. An example of the second method is given in the book before us. We quote as follows:

> The quantity of heat passing in one hour through 1 sq. m. of boiler surface increases in direct proportion with the difference in temperature between the liquid and the flue gases, and also probably with the square and cube root of the velocity with which the liquid and flue gases respectively pass along the wall. It diminishes, however with the growth of the coating of soot and dust on the outside of the heating surface and of the boiler-scale on the inside.
>
> . . . . . .
>
> The true coefficients of transmission for this case are not yet known with sufficient accuracy; many and varied experiments (which are still lacking) would be required to determine them. But a knowledge of these figures would not be of very great service, since the conditions which hinder the transmission of heat are very numerous and variable, and cannot be accurately taken into account either before or after construction. Thus it is necessary to be satisfied with applying the results of practical observations.
>
> If K be the coefficient of transmission of heat, which gives the number of units of heat (calories) passing through 1 sq. m. in one hour with the total difference in temperature, then we may reckon that with steam boilers K = 8,000 to 12,000 calories; in the mean, K = 9,000 calories.
>
> . . . . . .
>
> In the case of very small boiler surfaces, transmission of 18,000-20,000 calories may occur, yet this high efficiency causes wet steam, and does not generally result in economy of fuel.
>
> *Researches on the transmission of heat from flue gases and air to water which does not boil* have been performed by Joule and Ser; they show that the transmission is probably proportional to the square root of the velocity of the gases or air, v, and that the coefficent k for clean wrought-iron pipes is approximately
>
> $$k = 16 \sqrt{v} \text{ to } k = 19 \sqrt{v}. \qquad (30)$$
>
> Having regard to the coating of the heating surface with substances which hinder the transmission of heat, which always occurs in practice, we shall assume for this case the coefficient of transmission
>
> $$k = 2 + 10 \sqrt{v} \qquad (31)$$
>
> in so far as it refers to pure air. If the liquid is heated by flue gases, on account of the greater amount of coating in unfavorable cases, it is necessary to take
>
> $$k = 2 + 5 \sqrt{v}. \qquad (32)$$
>
> In the mean for this case, k may be taken at about 13.
>
> By means of this figure the following small table (omitted here.—Ed.) has been calculated; it shows how large the heating surface must be in order to heat in the boiler flue, in one hour, 100 liters of water from 10° or 15° to 80° or 130° C., when the flue gases reach the economizer at a temperature of 300°-400° C. and are there cooled to 150° or 300° by giving out heat.

The table referred to covers two pages of the book and contains data of the temperatures of combustion, volumes and analyses of the gases, thickness of the layer of fuel on the grate, percentage of ash, etc., of a variety of fuels, ranging from wood to water-gas, and the rate of evaporation for all the fuels is given as 15 to 20 kilos, averaging 18 kilos per hour per square meter of heating surface. Translating this into English it is 3.07 to 4.09 lbs., averaging 3.69 lbs per sq. ft. of heating surface per hour.

The quotation given above is a fair sample of the whole book. The extent to which the method is carried may be judged from the fact that there are no less than 308 numbered algebraic equations in the book, many of them containing logarithmic expressions, some of which are very complex. A table in the beginning of the book gives about 150 symbols and contractions used in the text, and some of these are Greek letters with double subscripts which are so small that they can scarcely be read without a magnifying glass. Although the book is intended for English readers, there is not a single English dimension given in it; all are in the metric system.

As to the subjects treated in the book, there are 36 chapters. The first seven, covering 55 pages, relate to the transmission of heat under different conditions. Then follow seven more chapters, 55 pages in all, on evaporating apparatus, including multiple effects; 40 pages are then given to the subjects of the pressure exerted by currents of steam and air upon floating drops of water, the motion of floating drops of water upon which press currents of steam, and the splashing of evaporating liquids. Three chapters, 45 pages, then treat of the diameter of pipes for steam, alcohol vapor, and air, and to the loss of heat from pipes. A chapter of 80 pages on condensers follows; then there are three chapters on heating liquids by steam and cooling them by ice, by partial evaporation, by air and other means; and the concluding four chapters are on air pumps and the vacua they produce. The amount of labor spent by the German author in preparing this book must have been tremendous, and the English translation of the text appears to be very good. The book may be found of service to a few engineers and students who wish to spend the time necessary to acquaint themselves with the theory of transmission of heat as applied in heating, cooling, evaporating and condensing, and to wrestle with some of the 308 formulae, but it is to be regretted that it gives practically no descriptions of such apparatus as the American engineer uses, and but few data derived from actual practice. A good practical book on the subject has yet to be written.

Fuel and Steam Calorimeters.

CALORIMETRY.—By Frank H. Bates. Vol. II. of the Industrial Gas Series. Philadelphia: Philadelphia Book Co. Leather; 4½ × 6¾ ins.; pp. 129; tables, and 28 figures in the text. $1.

This little book contains a compilation from various sources of information concerning fuel and steam calorimeters and their methods of operation. It is evidently not the work of an expert in the subject of which it treats, since its contents are a mixture of old and new, good, bad and indifferent.

The first chapter treats of units of heat, calories, and the like. The author defines the "British thermal unit" and the "calorie" in the usual way, and then says,

> Another unit often employed . . . is the "thermal unit," which may be defined as the quantity of heat required to raise one pound of water 1° C. at or about 4° C.

This making the thermal unit a different thing from the British thermal unit is, we think, a novelty, and one which is to be reprobated. The so-called thermal unit is a "pound-centigrade heat unit," or as some writers have called it, a "pound calorie."

The author gives the rule for converting calories into British thermal units, viz.: multiply by 3.968, but he neglects to point out that when the heating value of a fuel is given in calories it is converted into British thermal units by multiplying by 1.8 and not by 3,968.

In the course of the book the following calorimeters are described: The Junker gas; an oxygen calorimeter made by Messrs. Poole & Hitzeroth, of San Francisco, which seems to be a modified Mahler calorimeter; Carpenter's constant pressure Mahler's bomb; Lewis Thompson's; Parr's, which is a modification of Mahler's; and the barrel, Carpenter, and Barrus steam calorimeters. Thompson's instrument is described as suitable where comparative results will suffice, but not a word is said as to its general inaccuracy. Likewise, in the chapter on Berthier's lead reduction method of determining the heating value of a coal, the author says that the method

> has been almost universally condemned, yet owing to its simplicity and convenience over other methods the writer feels justified in recommending its use when the proportion of hydrogen in a fuel is approximately known and when exact heating values are not required.

Although space is taken to quote from a paper read before the American Society of Mechanical Engineers describing this method, and although he admits that it "has been almost universally condemned," yet he does not mention any of its bad features. The barrel steam calorimeter has also been long out of date.

The book contains a few conversion tables, and lacks one of the essentials of a reference book, a title on its back.

AMERICAN RAILWAY ASSOCIATION.—Proceedings from April 12, 1899, to Oct. 22, 1902, Inclusive. New York: The American Railway Association. Half leather; 9 × 12 ins.; pp. 1,071; tables. $5.

The only up-to-date treatises on the science and art of railway transportation are the proceedings of the railway associations. We know of no book on the locomotive, for example, from which the same practical information can be gained that is found in the transactions of the Master Mechanics' Association, and of the various local railway clubs. There is no book written that we know of on railway management; and the nearest approach to a treatise on the subject is the records of the official organization of railway managing officers of the United States of which the volume before us is the latest to be issued.

It is true, of course, that the information given in books of this sort is not arranged in the systematic order of a formal treatise. One may find a particular piece of information or he may not. He must hunt for what he wishes to find; but when he does find it he has the satisfaction of knowing that it is at first hand.

The volume before us covers the proceedings of the Association from April 12, 1899, to Oct. 22, 1902, during which period eight meetings were held. It is completely and carefully indexed, so that the searcher for information finds his task greatly simplified. As this index covers 22 pages and the book itself contains considerably over 1,000, we cannot attempt to give any statement of the subjects covered further than to say that it comprises everything which the Association has had under consideration during the past four years. The subjects of safety appliances, signals, car service, box car dimensions and train rules have received most attention.

NEUNTER INTERNATIONALER SCHIFFAHRTS-CONGRESS.—General Report. Berlin, Germany: The General Committee, L. Sympher, General Secretary. Cloth; 8 × 10½ ins.; pp. 780. $1.50.

The complete proceedings of the Ninth International Navigation Congress, held at Düsseldorf, Germany, June 29 to July 10, 1902, appear in this volume. Many of the reports and discussions are given in German, French and English, but most of the matter appears only in the German text. The work of the Congress, as noted in Engineering News at the time, was divided into sections, one

of which dealt with marine, the other with interior navigation. There were 83 different communications received, treating of six main subjects and 27 minor matters. Each subject was reported to the section meeting by a general reporter, who summarized the various contributions on that subject. These general reports are included in the present volume. There is a complete list of the members and a copy of the constitution as amended.

River Improvement for Navigation and for Flood Protection.

THE IMPROVEMENT OF RIVERS.—A Treatise on the Methods Employed for Improving Streams for Open Navigation by Means of Locks and Dams. By B. F. Thomas, M. Am. Soc. C. E., U. S. Assistant Engineer, and D. A. Watt, M. Am. Soc. C. E., U. S. Assistant Engineer. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 10 × 12 ins.; pp. 356; tables, 92 full-page and folding plates, and 26 figures in the text. $6 net; by mail, $6.47.

The systematic improvement of rivers for navigation is a public work which many students of transportation consider has never received the attention merited by its posibilities as a portion of the transportation system of modern commercial nations. The general accusation is not that engineers have failed to devise adequate means for river improvement, but that legislators have neglected to apply these means so as to develop systems of internal navigation by networks of improved rivers. Whether or not this neglect to improve the natural waterways, and the contrary activity displayed in building artificial canals which signalized the first part of the last century, was an economic error is a debatable matter; in either case it is a matter of little importance at present. The old boat canal is an obsolete and inefficient tool of transportation, as compared with the modern railway, and it is unlikely that any more will ever be built, unless to connect closely adjacent reaches of navigable river, or under similar exceptional circumstances. With the passing of the boat canal, however, increased interest has arisen, particularly in the United States, in works for rendering natural waterways suitable for barge and boat navigation. Within only a few years, for example, large expenditures have been made by the United States in improving the Ohio and other rivers for slack water navigation, and the tendency of legislation is toward still more liberal expenditures in the future. In view of these facts there has long been warrant for a book treating of the improvement of rivers for navigation, and it is a little surprising that none has appeared until now. On the whole, however, the book before us is well worth having waited for, particularly as it wisely departs from its immediate subject and treats at length of river improvement for flood protection, as well as for navigation.

In passing it should perhaps be also noted that the authors of this book have been personally in charge of some of the most important slack water navigation improvements carried out by the United States in recent years, and, in addition, have the reputation of being careful students of their subject.

The authors have divided their discussion into three sections or parts. In the first part they describe the preliminary work which has to be done before designing and constructing improvements; in the second part they describe the works utilized in the improvement of open rivers; and in the last part they describe the works employed in the canalization of rivers. In the second and third parts illustrations have been lavishly employed, and they are generally good and are nearly always well selected and practically useful. It is also worth noting that the authors have made copious use of quotations, and thus have given their readers the benefit of having special theories and descriptions of works in the words of those who originally presented them. This is a practice which has much to recommend it to the reader, and is only a just recognition of the work of others, although one which is often overlooked by text book writers.

Taking up the three parts or sections in more detail, it may be noted that in its opening chapter or introduction the book does little beyond coördinating the reader in a slight measure with the history of river improvement and acquainting him with the organization for administrating such works in the United States. Chap. II. continues the task of definition by explaining the meaning and significance of such terms as bed, basin, slope, shoals, and bars, and by discussing the physical characteristics of high water fluctuations and floods, river formation, and rainfall. The three remaining chapters of the section are devoted to an explanation of the preliminary examinations and surveys which necessarily precede the design and construction of improvement works, and to a description of the methods to be followed in making these examinations.

Topographical surveys and leveling and hydrographic surveys are each given a long chapter. In these chapters the method of treatment is not pretended to be exhaustive, and the reader is referred to special books on surveying for detailed methods and descriptions of apparatus. The chapter on hydrographic surveys is naturally the more exhaustive of the two, and goes quite thoroughly into questions of discharge, determination of sediment, and determination of slope.

In the first chapter of the section on "Improvement of Open Rivers" the authors discuss the removal of bars and other obstructions. As many of our readers know, this class of work is one of the most important tasks which confront the engineers whose duty lies in keeping open to navigation the Mississippi, Ohio, Missouri, and other large western rivers of America. Under the heading of "Expedients" an interesting account is given of the various devices which have at different times been suggested or employed as cheap substitutes for permanent improvements. These expedients have generally consisted of movable gates, swinging mattresses, etc., for deflecting the current, and of scrapers and stirring devices for loosening the bars so that the current could more easily remove them. Various of these devices are described, and it is pointed out that the principal trouble with all of them is that the current cannot be relied upon to perform its share of the work. The practice of dredging is next considered, various forms of dredges are described, and a special account is given of the well-known and extensive dredging operations being carried on by the Mississippi River Commission. The chapter closes with an account of the methods for removing snags, wrecks and other obstructions to river channels.

Regularization as a means of river improvement is the subject of a new chapter; in it are given a summary of foreign opinion and descriptions of several notable foreign works of river regularization. Dikes and their works are next discussed. The various forms of dikes are defined, and the purpose of each form is explained. There follows then a description of dike construction, including form of cross-section and the materials used in construction. Bank protection is next taken up, its object explained, and the various forms described. A full account is given here of the methods of bank revetment employed on the Mississippi River, including photographic views and diagrams illustrating the methods of work. The succeeding chapter is devoted to levee construction, and is a notably concise and intelligent account of the history, design, construction and maintenance of such works, both in the United States and abroad. A chapter on storage reservoirs as a means of flood protection follows, and we would particularly request those who regard this method as a panacea for all the ills of the Mississippi floods to read the plain matter-of-fact exposition which Mr. Thomas and his co-laborer present for consideration. The improvement of river outlets, including the formation and prevention of bars and methods of jetty construction, is next discussed.

This brings us to the section on "Improvement of Rivers by Canalization," which is opened by a chapter on general design and construction of works for creating slack-water, embracing the following topics: Location of locks and dams; investigating site; acquisition of site; arrangement of lock or dam; navigable depth; size of lock; lift of lock; height of lock walls; foundations; coffer dams; materials of construction; clearing of pool; general remarks on design. The two succeeding chapters discuss lock construction and the design and construction of lock gates and valves. In the chapter on locks a full discussion is given of the calculation of lock walls, and this is followed by a description of the details of construction and a special section on concrete locks. The calculations of lock gates are very fully discussed, and this is succeeded by descriptions of wood and metal lock gate construction in all details. Then follows a chapter on the design and construction of fixed dams, and then comes a series of six chapters on movable dams, which is undoubtedly the best practical treatment of such structures which is to be found in print. There is first a general discussion of movable dams, containing a brief history, the classification and definition, and the general discussion of design, size, etc. Needle dams, Chanoine wicket dams, gate curtain and bridge dams, shutter and A-frame dams, and drum wickets and bear-trap dams are there described and discussed in the order named. The illustrations are numerous and show details of construction in each case.

The book closes with three appendices on "Dimensions of Locks and Dams on Certain Rivers;" "Specifications;" and "Laws for the Protection and Preservation of the Navigable Waters of the United States." There is a satisfactory index.

STUDIE UEBER EINE NEUE FORMEL FUR ERMITTLUNG DER GESCHWINDIGKEIT DES WASSERS IN BACHEN UND KUNSTLICHEN GERINNEN.—By R. Siedeck. Vienna: W. Braumüller. Paper, 6 × 9 ins.; pp. 40; vii tables. 75 Cts.

Two years ago the author published a formula giving the mean velocity of flow in rivers and large streams in terms of depth, width, and slope. This formula was intended to apply to streams of a greater width than 10 m., but by a slight change in one of the terms the author now applies the formula also to streams from 3 m. to 10 m. wide. When the breadth of stream is less than 15 times the depth, a "profile factor" must be added. Some two hundred actual measurements of velocities of streams are listed for a comparison with the velocities calculated from the formula. The feature of the formula is the fact that it contains no term nor coefficient for roughness; while this gave good results for streams, in which the three factors of depth, width, and slope are in a way dependent upon the natural roughness of the channel, the conditions of flow in brooks or small artificial open channels are different. A formula for this case is derived, which assumes a zone of frictional influence along the bottom and sides of the channel. The flow in this zone is made dependent upon a resistance coefficient which varies with the nature of the channel. The results are compared with measured velocities.

DIE CENTRALHEIZUNG.—By Hugo von Seiller. Vienna: A. Hartleben. Paper; 6½ × 9 ins.; pp. 161; 116 illustrations; 23 tables.

The heating of buildings from a single furnace or heater is discussed in this work, which is intended as a handbook for the architect and builder. Air, steam and hot-water heating systems are described, with due attention to their relation to ventilation. Much of the book is given up to describing and illustrating the apparatus and fittings used. American practice is represented in only a few items. The last quarter of the book, entitled "Calculation of Heating Plants," outlines the method to be followed in designing such installations; this part includes many helpful data and values of constants required in calculation. It may be noted as an important omission that no mention is made of the "fan and heater" system of air heating, using steam coils for heating the air, which system has in recent years received such wide use in this country for heating shops, factories and public buildings. The book is not likely to be of much value to American engineers or architects.

CONGRES INTERNATIONAL D'AUTOMOBILISME.—Paris: Hemmerle & Son. Paper; 8 × 12 ins.; pp. 605; illustrated.

Among the congresses held at the Paris Exposition was one composed of engineers, manufacturers and others interested in automobiles. This congress held its meetings on July 9 to 16, at the House of the Automobile Club of France, and an

extended list of papers and reports was read and discussed. The present volume is a full report of the proceedings of the congress, and includes all the papers and discussions in full, a list of the members of the congress, and various other matters relating to its business and technical affairs. To engineers interested in tracing the history of self-propelled vehicles for common roads we can recommend as unusually complete the papers by Count Chasseloup-Laubat on "Automobile Locomotion in France," and "Automobile Locomotion in England," which are contained in this report.

A MANUAL OF WOOD TURNING.—By C. R. Richards, Professor of Mechanical Engineering, University of Nebraska. Lincoln, Neb.: University Book Store. Cloth; 12 × 13 ins.; pp. 20; illustrated. 75 cts.; by mail, 87 cts.

The author here presents a course of exercises in wood turning for engineering students. The drawings (full size in most cases), and the accompanying directions for doing the work, are printed on single sheets, which are intended to be used at the lathe as working drawings and instruction cards. The exercises are properly graded to give practice in the different tools and methods of the woodworker, beginning with a plain cylindrical piece between centers, and advancing by steps to difficult face-plate and chucking work. The first sheet gives an elevation of the speed lathe, whose working parts are described, and the next two pages show the lathe centers, face-plate, etc., and the tools used. The remaining sheets show the fifteen exercises which form the course (each on a separate sheet), and five special exercises. Wherever a new problem of handling the cutting tool is reached, a sketch is given to indicate the correct manner, and in each exercise the course of operations is described, with attention to those points where the student is apt to go astray. Probably every technical school in the country has a wood-turning shop, and probably in each one of these a regular course of exercises is laid out on blue-print instruction cards (which are sometimes models of poor lettering and often become nearly illegible from oil and dirt after a short time). The present set of sheets, which was evidently carefully prepared, is much fuller as to instructions than the usual blue-print card; the sheets are held removably in a pair of cloth covers by means of rings passing through perforations in the sheets, so that the whole forms a very convenient course manual to facilitate the instructor's work. It is possible, therefore, that many technical schools will find it an advantage to adopt this manual in their wood-turning work.

BRITISH STANDARD SECTIONS.—Issued by The Engineering Standards Committee, Supported by the Institutions of Civil, Electrical and Mechanical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute. Leslie S. Robertson, M. Inst. C. E., Secretary. New York: D. Van Nostrand Co. Paper, 9 × 15 ins.; pp. 9; tables and diagrams. $1.

This series of sheets gives the dimensions, thickness and profile of the standard steel sections, as established by the committee named. A sheet each is devoted to equal angles, unequal angles, bulb angles, bulb tees, bulb plates, Z-bars, channels, I-beams and T-bars. Each sheet consists of a diagram section of the shape with reference letters to a table of dimensions and of a brief explanation of the section.

GEOLOGIC ATLAS, NEW YORK CITY FOLIO.—Washington, D. C.: U. S. Geological Survey. Heavy paper; 18½ × 21½ ins.; pp. 50; maps and other illustrations. 50 cts.

The text gives an excellent summary of the geology of the 905 sq. miles covered by the maps of this folio. The folio includes the Paterson, Harlem, Staten Island and Brooklyn quadrangles, thus covering a large area of New Jersey as well as New York city and surrounding country. Each of these quadrangles is contoured (20-ft. intervals) and mapped topographically, but in addition the folio contains four historic geology sheets, four superficial geology sheets and one structure-section sheet. To engineers and contractors of New York city and vicinity this folio should prove invaluable. Its price is merely nominal, and may frequently be the means of saving many hundreds of dollars.

LEAD POISONING AND WATER SUPPLIES.—Papers Submitted by the Medical Officer of the Local Government Board, and Report by Dr. Houston on Moorland Waters in Regard to their Action on Lead. Supplement to the Report of the Local Government Board, 1900-1. London: Eyre & Spottiswood. Paper; 6 × 9 ins.; many folding and other plates of maps and diagrams. $3.75.

This report, the preface to which is dated September, 1902, is the first part of a final report on studies begun some ten years before. An interim report was published in 1895. It appears that Dr. Houston has been working on the subject at intervals through all these years. Part I. of the report is entitled "Differential Examination, at Weekly Intervals and Over a Prolonged Period, of Waters of Diverse Sort from One and the Same Moorland Gathering Ground." The studies included physical and chemical examinations of water, the results of which are shown by detailed tables and 47 diagrams. Some bacterial studies are also included in this section. In Part II. particulars are given regarding each of the 23 separate drainage areas "surveyed." Maps, rainfall tables and results of chemical examinations are included. In the final section there is presented a general review of the subject in the light of the various drainage areas studied. It is concluded that "epidemics of lead poisoning due to water supply," at least in Northern England, have been in towns supplied with moorland water, and that such waters are generally both peaty and acid, and will dissolve lead. What is termed "plumbo-solvent ability" may be removed by "suitable arrangements for neutralization," which may be advantageously combined with slow sand filtration. This extended and apparently careful investigation of lead poisoning as related to public water supplies suggests the similar, but less detailed, reports on the same subject by the Massachusetts State Board of Health in its annual reports for 1898 and 1900.

THE MANUAL OF STATISTICS.—Stock Exchange Handbook for 1903. New York: The Manual of Statistics Co. Cloth; 6 × 8 ins.; pp. 1,044; tables and folding maps. $5.

The present issue of this work is about 130 pages larger than the one for 1902. The greater part of the space is devoted to railroad and industrial securities. The property and securities of a large number of companies are described, and financial statistics for each, sometimes covering a series of years, are given. The names of the officers of the companies are, of course, included. Stock exchange quotations from various centers, and a variety of other matter, are also given.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.—Report of the Convention at Richmond, Va., Oct. 7 to 9, 1902. Frank P. Foster, secretary. Cloth; 6 × 9 ins.; pp. 209; illustrated. Corning, N. Y.: The Secretary.

The following papers are included in this report: "Municipal Inspection and Control of Electrical Matters," by Walter M. Petty; "Relation of Electrical Interests to Other Branches of the Municipality," by Capt. Wm. Brophy; "The Telephone Service in Connection with the Fire and Police Telegraph Signal Systems," by Jerry Murphy; "Joint Use of Conduits" (for all classes of wires), by Charles F. Hopewell. An abstract of the latter paper was published in Engineering News for Oct. 16, 1903. The illustrations included in the report are half-tone portraits of officers of the association.

ELECTRIC LIGHTING STATISTICS.—Bulletin No. 6, League of American Municipalities. Paper; 9 × 12 ins.; pp. 8; tables. Des Moines, Ia.: The Secretary.

Statistics from 53 municipal and 168 private plants in places of 5,000 and upwards listed in "The Municipal Year Book" were obtained by the League, by correspondence, and are included in this bulletin. The tables include quite a variety of information regarding the character and extent of the various plants, and the prices charged for public and commercial lighting.

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WATER SUPPLY AND PREVENTION OF WASTE IN LEADING EUROPEAN CITIES.—Report by Columbus O. Johnson, ex-Water Registrar of New York City, to the Merchants' Association of New York. New York: Merchants' Association. Paper; 6×9 ins.; pp. 289; tables and illustrations.

This report consists, first, in a series of letters from Glasgow, Liverpool, Manchester, Birmingham, London, Paris, Cologne, and Berlin, in which the water supplies of each city are briefly described, and information is given regarding the means employed to detect and prevent waste. The rules and regulations governing the supply of water to private consumers are given in each letter, save the one on Liverpool. The second part of the report, comprising almost two-thirds of the volume, contains extracts from water department reports, including balance sheets. Here also may be found reproductions of blank forms of agreements, notices, due bills, and the like, and schedules of rates charged for water, and conversion tables for use in making up bills.

The report as a whole contains much valuable information, but the information might have been made far more valuable had it been gathered and edited with more discretion, and with a more intimate knowledge of water-works practice. A large part of the report is worse than useless, since it occupies much space and involves expense that might have been more advantageously incurred in other directions. Thus we have page after page of tables showing, *in shillings, pounds, and pence*, the general and the water taxes for properties of different values; the gross, the discount, and the net general tax rate, water rate, and water rent. Bad as are these tables, they are surpassed by "Appendix C—Exhibit I.," showing the total cost, also in pounds, shillings, and pence, of water supplied through meters in Manchester, England, for quantities varying by 1,000 gallons from 1,000 up to 3,000,000 Imperial gallons. In the early part of this table the charges are carried out to variations of ¼ pence. Thus, American engineers and superintendents who wish to know the exact cost of 1,867,000 Imperial gallons of water in Manchester may here find it to be exactly £45 6s. 4¼d. Really, this table of 10 pages of small type would have been more interesting and almost as instructive had it been printed in Chinese characters.

In conclusion, the report is valuable for partly showing how water waste is kept at a minimum abroad, how close track is kept of the consumption, and also of cost of construction and operation, and of the revenue; and what sort of blank forms are used, and how the accounts are kept. On the other hand, the author fails to recognize that house-to-house inspection, and the Deacon waste-detection meter, are only partial measures to prevent waste, and have, particularly under American conditions, but little permanent effect upon the wilful waste of water by consumers. He presents but meager data, at best, on the reasons for the relatively low consumption of water, regardless of waste, in foreign as compared with American cities. He presents page upon page of useless "Exhibits," and does little towards pointing out the significance of such exhibits as are valuable.

MOSQUITO EXTERMINATION IN SOUTH ORANGE.—Report of Committee of Village Improvement Society for Season of 1902. Spencer Miller, M.Am.Soc.C.E., Chairman. South Orange, N. J.: The Society. Paper; 6×9 ins.; pp. 16.

This is an interesting and instructive account of a campaign, or two campaigns against mosquitoes carried on in 1901 and 1902 by a committee of a local improvement society. The necessary funds for the work were raised by subscription. About $600 was expended in 1901 and $1,200 in 1902. The chief items of expense were the purchase and spreading of oil, and the drainage of wet places. In 1902 crude petroleum oil was used. The committee rightly believes that oil is a temporary and drainage a permanent measure, but states that drainage is not always practicable.

MUNICIPAL CIVIL SERVICE EXAMINATION PAPERS. —No. 1. New York: William Beverly Robinson. Paper; 4½ × 7 ins.; pp. 149; illustrated. 25 cts.

It is stated in the preface to these "Papers" that they cover all examinations made with any degree of frequency by the Municipal Civil Service Commission of the City of New York. Their usefulness, if this be true, is obvious.

THE RESTORATION OF ANCIENT IRRIGATION WORKS ON THE TIGRIS, or The Re-Creation of Chaldea. By Sir William Willcocks, M. Inst. C. E., late Director-General of Reservoirs, Egypt. Being a Lecture Delivered at a Meeting of the Khedival Geological Society, Cairo, March 25, 1903. With two Appendices: A—Meteorological Information About Bagdad; B—Egypt Fifty Years Hence. Cairo, Egypt: National Printing Department. Paper; 6×9 ins.; pp. 21; 10 folding plates.

This is not an essay designed merely to entertain an audience for an hour, or to disseminate information regarding ancient peoples and their great public works. While the address has doubtless served both purposes it goes much further and presents a carefully worked out preliminary report and estimate on a vast irrigation system to render again productive and populous an ancient center of population, teeming with life and activity, all made possible by irrigation. The vast irrigation system briefly described in the opening part of the paper was, the author believes, destroyed by a change in the course of the River Tigris, which cut off the water supply from the canals and caused untold numbers of people to perish from famine and pestilence. The author advocates a thorough study of the restoration of these old irrigation works, to be made in connection with the development of the Bagdad Railway. The proposed irrigation works, he believes, would be a most important factor in the success of the railway.

IRRIGATION BRANCH OF THE PUBLIC WORKS DEPARTMENT IN THE MADRAS PRESIDENCY.—Report for 1901-2. Madras, India: Pub. Doc. Boards; 8 × 13 ins.; pp. 116; tables, and one folding map. 5¼ shillings; in the United States, $2.

This report consists chiefly of statistical tables and financial accounts relating to the irrigation canals and works of the country named. From the brief text and summary preceding the detailed tables it appears that a total of 2,657,657 acres, under nine different systems, were irrigated for the first crop of 1901-2, and 324,015 for the second crop.

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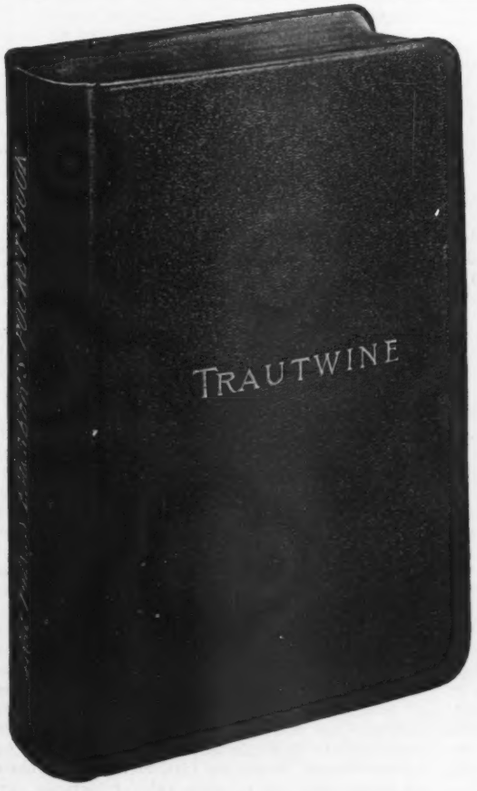

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WATER SUPPLY AND IRRIGATION PAPERS OF THE U. S. GEOLOGICAL SURVEY.—Chas. D. Walcott, Director; F. H. Newell, Hydrographer in Charge. Washington, D. C.: Pub. Docs. Paper; 6 × 9 ins.

No. 66: Operations at River Stations, 1901. Part II. (West of Mississippi River); pp. 188; tables.

No. 68: Water Storage in the Truckee Basin, California-Nevada. By L. H. Taylor; pp. 90; tables, 8 plates, and 20 figures in the text.

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No. 76: Observations on the Flow of Rivers in the Vicinity of New York City.—By Henry Albert Pressey; pp. 108; tables, 13 plates, and 8 figures.

No. 77: The Water Resources of Molokai, Hawaiian Islands.—By Waldemar Lindgren; pp. 62; 4 plates.

A group of these papers was noticed in the Supplement for Jan. 15, 1903. Of those here treated, No. 66 is a continuation or conclusion of one already noted. In No. 75, on stream measurements in 1901, Mr. Newell supplements Nos. 65 and 66 ("Operations at River Stations") by presenting the results of computations of river flow and the conclusions therefrom, together with maps and other illustrations. Hereafter, we are pleased to say on the authority of this number, it is proposed "to combine and publish together the original observations and results for each locality." No. 68, on water storage in the locality named, discusses and describes reservoir sites, the present uses of water and existing rights, irrigable lands, proposed canals, and possible development of water power. No. 73, on a similar subject, but for a different locality, relates wholly to two proposed reservoirs in Arizona, presenting the results of borings and other studies for dams, with plans and estimates for the latter. In the case of the proposed Salt River dam, which we understand from other sources is likely to be one of the first to be built in the West by the U. S. Government, specifications for a masonry dam are given. It is proposed to build a cement plant in the vicinity, and also to establish a hydro-electrical power plant for use in making cement, and for other purposes.

Mr. Pressey's study (No. 69) of Maine water powers is the first paper in the series to give such specific and exclusive attention to this phase of the water supplies of the United States. He takes up the various rivers, some briefly, and some in detail. Of the latter, the Kennebec, for instance, is considered from the view-points of its drainage basin, lake storage, water powers, and flow. Under the latter head there are a number of tables giving daily discharge in feet per second, together with run-off and rainfall. The monthly discharges are also shown by diagrams.

The three papers on water resources of various sections (Nos. 70, 74 and 77) consider the subject in its various aspects, including its relation to irrigation. In No. 70, geology is taken up, and also timber, grass, and agricultural products. No. 74 gives numerous Colorado stream measurements, and No. 77 relates more particularly to the ground than to the surface waters of Molokai.

Professor Taylor's paper is supplementary to No. 13, in the same series, by Mr. Wm. F. Hutson, prepared in 1897. The present paper includes later developments, and is, Mr. Newell states in his letter of transmittal, a more thorough survey of the field. The principal irrigation systems of the State are described, something is said about rice irrigation, and there is an appendix relating to Texas irrigation laws.

Mr. Pressey states that the "Observations on the Flow of Rivers in the Vicinity of New York city" (No. 76), were begun by the Survey in 1901 at the suggestion of Mr. George Birdsall, then head of the water supply department of New York city. Seven gaging stations were established, on the Ten Mile, Housatonic, Catskill, Esopus, Wallkill, Rondout and Fishkill. Results of measurements, including some observations of velocities under the ice, are given; also tables of observed turbidity, color, and alkalinity, and discussions and illustrations of apparatus.

NEW YORK COLLEGE OF FORESTRY, CORNELL UNIVERSITY.—Report for 1902. B. E. Fernow, Director, Ithaca, N. Y. Albany, N. Y.: Pub. Doc. Paper; 6 × 9 ins.; pp. 32.

This report opens with a statement by President Schurman, in which he calls attention to the fact that in five years the college has grown from an attendance of 7 to 70, and that of the 70 there are 15 who hold Bachelors' and Masters' degrees from colleges and universities. Besides the instruction at Cornell, much important work is done at Axton, which is located in the 30,000 acres of land in the Adirondacks which the state has placed at the disposal of the college. Here scientific forestry and lumbering are being carried on. Director Fernow reviews the work of the year, calls attention to the need for better accommodations for the college at Ithaca, answers the criticisms of uninformed persons regarding alleged denudation of forest lands by the college, and lays down "twelve theses" as a formulation of forestry philosophy.

NEW YORK FOREST, FISH AND GAME COMMISSION. —Report for 1901-2. Albany, N. Y.: Pub. Doc. Paper; 7 × 10 ins.; pp. 164; many half-tone plates and two folding maps.

Most of this report is devoted to forests and forestry work, including the planting of seeds and seedlings and gathering seeds. There is a special report on chestnut groves and orchards. Attention is called to the well-intentioned but nevertheless unfortunate and unwise provision of the state constitution which prohibits removing timber from the state forest lands, and thus prevents the removal and sale of mature trees, or even of windfalls, or trees killed by fire. The report is handsomely gotten up, but is not such large type, heavy leading, wide margins, and so many half-tones that are only remotely related to the subject a misuse of public funds? That is, could not the money be used by the commission to much better advantage in the direct line of its work?

THE PRACTICAL VALUE OF PRESUMPTIVE TESTS FOR BACILLUS COLI IN WATER.—By Geo. C. Whipple. Reprinted from the Technology Quarterly, vol. xvi., No. 1 (March, 1903). Address the author, Mt. Prospect Laboratory, Brooklyn, N. Y. Paper; 7 × 10 ins.; pp. 14; tables and diagrams.

This paper was first presented by Mr. Whipple before the Laboratory Section of the American Public Health Assocation at New Orleans, Dec. 8, 1902. It is a valuable discussion of a most vital subject, and might be secured with profit by all in any way responsible for the character of public water supplies. The author concludes that the fermentation of dextrose broth is "the most rapid and practical test for the presence of Bacillus coli in water," and that the test named is useful for the determination of "the sanitary quality of water, and is one which gives results that agree well with chemical and biological analysis.

STATISTICAL REPORT OF LAKE COMMERCE Passing Through Canals at Sault Ste. Marie, Mich., and Ontario, During Navigational Season of 1902. Prepared under direction of Major W. H. Bixby, Corps of Engineers, U. S. A. Paper; 8 × 14 ins.; pp. 8. Address Major W. H. Bixby, U. S. Engineer Office, Detroit, Mich.

One of the most wonderful rivers of traffic in the world is that which flows up and down the St. Mary's River at the mouth of Lake Superior. In the season of 1902 the total traffic over this route was 35,961,146 net tons, an increase of over 7,000,000 tons over the record of the previous year. The astonishing growth of the lake traffic is perhaps best illustrated by the fact that it has actually doubled in the past six years. No longer ago than 1896 the traffic was only 16,239,000 tons; and if we go back six years farther we find that the traffic was then in 1890 only 9,000,000 tons.

It is not safe to draw extravagant deductions from these figures, however, respecting increase in freight traffic on waterways. The facts are that the phenomenal growth of the traffic to and from Lake Superior is due to nothing else but the development of the vast ore deposits in the Lake Superior district. Of the nearly 36,000,000 tons of freight passing the Sault last year, 24,277,000 tons was iron ore. We have to go back no further than 1893 to find this 24,000,000 tons reduced to 4,000,000 tons. When we turn to the other items of freight we find no such rate of increase. In

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flour, for example, the figures show that more barrels of flour passed the Sault in 1894 than passed last year. More building stone was shipped a dozen years ago than is shipped now. As much grain other than wheat was shipped in 1896 as in 1902. If we take the statistics of all freight other than iron ore we find that the traffic of the St. Mary's River has grown in round figures from 700,000 tons in 1880 to 4,000,000 tons in 1890 and 12,000,000 tons in 1902. These figures are far more reliable as illustrations of traffic growth than the figures which include the iron ore shipments.

We lay stress on this matter, because the growth of traffic at the Sault has been made the basis of all sorts of wild statements concerning the possible developments of water transportation routes. The real facts regarding the growth of traffic are so interesting and so important that this systematic record of them is very well worth while and cannot fail to be useful to engineers.

State Boards of Health and Registration Reports.

CONNECTICUT STATE BOARD OF HEALTH.—Report for 1902, and Registration Report for 1901. Dr. C. A. Lindsley, Secretary. New Haven, Conn.: Pub. Doc. Cloth; 6 x 9 ins.; pp. 565; tables and folding map.

Two topics of general interest in this volume are a brief "Report on the Inspection of Summer Resorts," by Mr. Geo. C. Ham. C. E., and "The Normal Distribution of Chlorine" in Connecticut, by Prof. Herbert E. Smith and Frederick S. Hollis. The report on chlorine is accompanied by averages of chlorine determinations, and a chlorine map of the State.

NEW JERSEY STATE BOARD OF HEALTH.—Report for 1901-2. Henry B. Mitchell, Secretary. Cloth; 6 x 9 ins.; pp. 365; tables and illustrations. Trenton, N. J.: Pub. Doc.

A valuable new feature of this report is a brief description of the sewerage systems of the State, giving the year sewers were first put in use, their mileage, and the means of disposal. The volume also contains a report on stream inspection, and a tabular description of the public water supplies of the State.

MICHIGAN STATE BOARD OF HEALTH.—Report of Henry B. Baker, M. D., Secretary, for 1900-1. Cloth; 6 x 9 ins.; pp. xxiv., 268; tables and diagrams. Lansing, Mich.: Pub. Doc.

As usual, this report contains extended studies, mostly in statistical form, of sickness and mortality in Michigan. There are also many meteorological tables.

ONTARIO VITAL STATISTICS.—Report for 1901. P. H. Bryce, Deputy Registrar-General. Ottawa, Ont.: Pub. Doc. Paper; 7 x 10 ins.; pp. 263; tables.

MICHIGAN REGISTRATION REPORT, 1900.—Fred. M. Warner, Secretary of State. Cressy L. Wilbur, M.D., Chief of the Division of Vital Statistics. Lansing, Mich.: Pub. Doc. Cloth; 6 x 9 ins.; pp. 272; tables.

Of these two reports on vital statistics the one from Michigan is of more general interest, since it has comparative statistics for other countries, includes meteorological tables, and contains more text.

Educational Reports and Pamphlets.

U. S. COMMISSIONER OF EDUCATION.—Report for 1900-1.; Vol. II. Washington, D. C.: Pub. Doc. Cloth; 6 x 9 ins.; pp. 1217 to 2512; tables.

This report contains a brief chapter on "Agricultural and Mechanical Colleges," which gives some information of changes in methods and courses of studies, and on new buildings, and also includes some statistics. Another brief chapter takes up "Manual and Industrial Education," and there are a few pages on "Commercial and Business Schools." Finally, out of this bulky volume devoted to a variety of educational topics, there may be mentioned a chapter on "Instruction in Mining Engineering," in which notes on 36 institutions are given, varying from general statements of two or three lines to fairly detailed accounts of three pages.

FROM HIGH SCHOOL TO COLLEGE.—By Thomas M. Drown. President of Lehigh University. South Bethlehem, Pa. An Address Delivered at the Dedication of the New Buildings for the Central High School of Philadelphia, Nov. 22, 1902. Reprinted from "Science," April 3, 1903. Paper; 6 x 9 ins.; pp. 17.

The graduate of the best American high schools, President Drown says, is as well prepared for his life work as was the college graduate of fifty years ago. This is partly due to the recent advances in the requirements for college entrance. With these advances the speaker held that the Eastern colleges might well have waived entrance examinations, accepting diplomas and a signed statement from school principals instead, and thus doing away with

a break in our educational system which affects unfavorably the high school preparatory to college, inasmuch as this course is then too apt to have for its aim the successful passing of examinations rather than a serious preparation for advanced work.

UNIVERSITY OF COLORADO.—Bulletin No. 4. Boulder, Colo.: The University. Paper; 7 x 10 ins.; pp. 112.

In this bulletin are published the addresses and speeches delivered at the quarto-centennial celebration of the University, held Nov. 13 to 15, 1902. Among the speakers and subjects were the following: "The Potency of Engineering Schools and Their Imperfections," by Prof. Dugald C. Jackson, of the University of Wisconsin; "The Past, Present and Future of the University" (of Colorado), by President James H. Baker; Oration by President Jacob Gould Schurman, of Cornell University.

Literary Magazines.

"Photographing the Nebulae" is the tile of an interesting paper in "Harper's" for May. We commonly think of photography as a means of making a permanent record of visible objects; but in astronomical work photography reveals things which the keenest eyesight could never discover. The sensitive gelatine film may be called a cumulative eye. The gleam of light far too faint for the eye to perceive, when it acts for hours on a sensitive film produces a definite image. The great six-foot reflecting telescope built by Lord Rosse of Ireland 60 years ago gave no better results than are now obtained by the aid of photography with a small reflecting telescope 1 ft. in diameter and 6 ft. long. The author of the paper further points out that by building a reflecting telescope of a size comparable with some of the large modern refractors, it would be possible to take stellar photographs of stars giving only one-fiftieth of the light of the faintest stars visible with the large refractors. In other words, it would enable us to see seven times as far into space as is now possible.

In the May "North American Review," Mr. L. de Muralt, a Swiss engineer, attempts to answer a recent paper in the same magazine by Mr. Cornelius Vanderbilt, and to show that electricity can displace the steam locomotive for general railway service. Mr. de Muralt's argument, however, does not appeal to us as by any means sound. Without reviewing it in detail we may mention for example that he dilates at length on the great economy of the electric over the steam locomotive for switching purposes. Apparently it has never occurred to Mr. de Muralt that his theoretical economy is of no practical importance in view of the fact that nobody has ever devised any plan by which electric current could be successfully supplied to switching locomotives in a large yard. Mr. Vanderbilt's position was entirely sound and was evidently based on a far more accurate knowledge of actual railway operating conditions than his would-be critic possesses.

Another "North American Review" paper is entitled "The Monroe Doctrine from an English Standpoint." The writer points out how greatly conditions have changed since the Monroe doctrine was first enunciated and shows the dangers of the present situation, in which the United States is becoming to a certain extent responsible for the behavior of chaotic and semi-anarchistic governments in Central and South America.

Apropos of recent excited utterances in the press regarding German naval ambitions, Carl Blind, in the "North American," shows that the real object of Germany's enlarged navy, like that of Great Britain, is national defence and not offence. He shows that with Russia on the one side and France on the other, Germany, for its national safety, is forced to build a navy to protect its ports and commerce.

In the May "Scribner," the organization of the

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United States Navy Department is described by the distinguished pen of Capt. A. T. Mahan. The much criticised "bureau system" is described in detail; and various features in which improvement in the organization is needed are set forth.

Another paper relating to a Government Department is "The Hampered Executive," in the May "Century," by Prof. Henry Loomis Nelson. The article sets forth the fact that the President is far from being the powerful force in the government that he is popularly supposed to be, and urges that the office should be freed from some of its present thraldom to Congress.

Turning to the English Reviews we find in "The Contemporary" for April a paper by "Robert Donald" entitled "The Case for Municipal Trading," which we heartily commend to any of our readers who desire authentic information as to actual English experience in this matter. Mr. Donald shows that the municipal ownership of public utilities in England is extending very rapidly, and that it is not producing the evil results that its opponents claim. On the contrary, it is proving profitable from every point of view.

PROCEEDINGS OF NATIONAL CONVENTION UPON MUNICIPAL OPERATION AND PUBLIC FRANCHISES.—Vol. VI., No. 4, "Municipal Affairs." Paper; 7 x 10 ins.; pp. 509 to 882. New York: Reform Club, Committee on City Affairs. $1.

The recent convention for the discussion of municipal ownership, and the prompt publication of the proceedings in such good form at so moderate a price, are alike due to the public spirit which has led the Committee on City Affairs of the New York Reform Club to do other valuable work for the improvement of cities and the enlightenment of citizens. A report of the convention was published in Engineering News of March 5, 1903. No one at all interested in municipal ownership could spend a dollar to better advantage than in the purchase of this report.

SHOULD CALIFORNIA MUNICIPALITIES OWN THEIR OWN WATER-WORKS; and if So, How Shall They be Acquired? By Arthur L. Adams, M. Am. Soc. C. E. (Address the Author, Oakland, Cal.) Paper; 6 x 9 ins.; pp. 21.

The author of this paper is General Manager and Engineer of the Contra Costa Water Co., of Oakland, and well known among the hydraulic engineers of the country. His previous connection with municipally-owned water-works, combined with the position which he has held for a number of years, gives added weight to the opinions expressed in this discussion. He considers iniquitous the constitutional provision under which the governing bodies of California municipalities establish annually the water rates to be paid to private companies, and he opposes propositions for building municipal plants to compete with existing private works. As an academic question he considers that there is, or need be, but little difference in the cost of water under public and under private ownership. The present unseemly yearly strife over water rates in California might be stopped by: (1) Obtaining a supreme court decision defining what constitutes a reasonable water rate; by providing, if possible, for publicity of accounts, under state control and by preventing competition; (2) municipal ownership, if "wisely instituted"; (3) a constitutional amendment providing for fixing water rates by impartial authorities at intervals of five or ten years, supplemented by the measures named in (1). In the opening part of his paper the author seems to have underrated the strength of municipal ownership of water-works in the United States and particularly the present movement to that end.

REPRODUCTIVE UNDERTAKINGS CARRIED ON BY MUNICIPAL BOROUGHS.—Return of Local Government Board in Accordance with the Order of the House of Commons, Aug. 4, 1898, Brought up to March 31, 1902, in Continuation of Parliamentary Paper No. 88, Session of 1899. London: Eyre & Spottiswood, Printers to the King. Paper; 8 x 13 ins.; pp. 144; tables. $1.00.

Aside from two pages of explanatory matter and a two-page statistical summary this return consists of statistical reports on municipal ownership from 299 municipal corporations in England and Wales. The statistics for each place are on facing pages and give for each municipality its various reproductive or revenue-producing undertakings, the date established, the status of the capital and sinking fund accounts on March 31, 1902, and the average annual gross income, working expenses, net profit or loss and allied figures for the past four years. Four columns are devoted to the figures on capital, and twelve to those on income, expenses and profits. All but 18 of the municipal corporations in England and Wales, or 299 out of 317, have one or more undertakings. The number of boroughs carrying on undertakings, as named below, is as follows: Water-works, 193; gas works, 97; electricity supply, 102; tramways, 29 (besides which 16 municipalities own but do not operate street railways); markets, 228; baths and washhouses, 138; burial grounds, 143; working class dwellings, 24; harbors, piers, docks and quays, 43; miscellaneous, 16. Obviously the statistics in this report are of unusual interest to students of municipal ownership.

NEW YORK STATE ENGINEER AND SURVEYOR.—Report for the Year Ending Sept. 30, 1902. Edwin A. Bond, State Engineer. Cloth; 6 x 9 ins.; pp. 424; also, supplementary report, pp. 381; tables, half-tone plates, folding maps, and diagrams. Albany, N. Y.: Pub. Doc.

This report, which, by the way, will not be generally available for two weeks or so, is opened by Mr. Bond with a general survey of the work of the year. There is a brief history of the Erie Canal, from its inception in 1868 to Mr. Bond's barge canal report in 1901; an outline of highway improvements under the State aid law, an account and tabular results of tests of stone for road building, and a discussion of a proposal to issue $50,000,000 of 3% bonds for highway improvement.

Following the main report is a special report by Mr. Wm. Pierson Judson, Deputy State Engineer, on "Lake Ontario Harbors for Canal Commerce." Reference to the latter is made on the editorial page of this number of the Engineering News. The "New York and Canada Boundary Line" is next taken up in detail, after which there is a full report of a convention of highway supervisors, a report by Mr. Frank D. Lyon, Special Examiner of Highways, and a number of other department reports, including one on cement tests, and one on bridges. Next come the reports of Mr. H. A. Van Alstyne, W. H. H. Gere and A. J. Rockwood, Division Engineers for the Eastern, Middle and Western Divisions, respectively. Canals, bridges, drainage, and highways are covered in these reports.

Many will heartily welcome the publication, this year, of the "Report on the Volume of Discharge of Streams" in a separate volume. This report is made by Mr. Robt. E. Horton, who has had local charge of the work, under the direction of Mr. Bond, and of Mr. F. H. Newell, Chief of the Division of Hydrography, U. S. Geological Survey. The report is a cumulative one, including the matter on the same subject previously published, with corrections and with additions, to cover both the work of the calendar year 1902, and earlier records gathered from various sources. In general, there are given the mean daily discharges in cubic feet per second, with means for each month, for a large number of New York streams. The tables are supplemented by diagrams. In some cases the data run back to 1898, or even earlier, and for the Croton there are runoff and rainfall tables extending back to 1868.

NEW JERSEY FLOODS OF MARCH, 1902.—Effect of Proposed Drainage Works in Passaic Floods. By C. C. Vermeule. From the Annual Report of the State Geologist for 1902. Paper; pp. 31; tables and diagrams. Address the State Geologist, Trenton, N. J.

Mr. Vermeule's well-known report on the "Water Supply of New Jersey," combined with the interest naturally awakened in the floods which did so much damage at Paterson last year, will doubtless create no small demand for this pamphlet, or for the report from which it is reprinted. The author believes that by the adoption of storage plans the enormous marshes on the middle Passaic would be converted into useful and healthful reservoirs, thus making drainage unnecessary, and yielding other important benefits.

ENGINEERS' POCKETBOOK.—A Manual of Useful Information and Tables Appertaining to the Use of Structural Steel as Manufactured by Passaic Steel Co., Paterson, N. J. By Geo. H. Blakeley, M. Am. Soc. C. E. Leather; 4 x 7 ins.; pp. 324; illustrated. $2.

This is a new edition of the well-known pocketbook of steel shapes, tables and formulas issued by the Passaic Steel Co., and it has been changed from previous editions only in minor details. Its contents are well explained by the following extract from the preface.

The tables, with a few exceptions, were computed expressly for this manual, and many of them are original in both matter and in form. Special care has been exercised in the arrangement of the tables to make them compact in form and convenient for the use of the designer. Special attention is directed to the extensive tables showing the proper spacing of steel beams for various floor loads, also to the very complete and extensive tables giving properties and safe loadings for various types of columns, the latter being, as far as the author is aware, the most extensive tables of the kind published. The formulas and tables for medium steel columns, original with the earlier editions of this work, have since been practically adopted by the Building Department of New York city. The formulæ for timber columns, also original with the earlier editions of this work, have found a ready use, acceptance and adoption by engineers. Other special features of the work will be apparent upon examination. Such of the tables as were not calculated for this work were obtained from works of presumably independent origin, which were compared for the detection of errors. The tables of the weights and ultimate strengths of materials were compiled by comparison of all the available data on the subject. No attempt has been made to encumber the work with abridgments of mathematical tables, as such tables to be of value must be more extended and complete than the scope of this work warrants. Only such matter is given as the author has found to be of service in his own practice.

DIRECTORY OF DIRECTORS IN THE CITY OF NEW YORK.—New York: The Audit Co. of New York. Cloth; 6 x 8 ins.; pp. 1,124.

The fifth annual issue of this "Directory" is like the previous ones, except that it contains more entries. It consists, first, of an alphabetical list of names, followed by the companies with which the persons in question are connected; and, second, an appendix, consisting of a classified list of companies, with their officers and directors.

CONNECTICUT HIGHWAY COMMISSIONER.—Biennial Report, 1901 and 1902, Including History of the First Stone Crusher and the Public Laws Governing Town Management of Highways. James H. McDonald, Commissioner, Hartford, Conn. Cloth; 6 x 9 ins.; pp. 304 + 64; tables and folding map.

This report is commended to those wishing to follow the detailed workings of State aid for highway improvement, designed particularly with a view to encourage the small towns to secure the benefits of such work, and, at the same time, aiming to develop a trunk system of good roads throughout the State. Of 168 towns in Connecticut, all but six have availed themselves of the State road appropriations, and some have done this every year since the beginning of State aid in 1895. Besides the general review for the State, and the local descriptive and statistical reports, the volume includes "State Specifications" for macadam, telford, gravel, gravel-telford, and grading. The story of the "First Stone Crusher in the World," patented in 1858 by Eli Whitney Blake, of New Haven, Conn., a nephew of Eli Whitney, of cotton gin fame, is told in an interesting manner by Mr. Macdonald.

THE ACTION OF THE SEPTIC TANK ON ACID IRON SEWAGE.—By Leonard P. Kinnicut and Harrison P. Eddy. From the Fourth Report of the Connecticut Sewerage Commission. Paper; 6 x 9 ins.; pp. 22; tables, and one illustration. Worcester, Mass.: Address the authors.

An abstract of this paper was printed in Engineering News of April 2, 1903.

Publications Received.

MODERN MACHINE SHOP TOOLS.—Their Construction, Operation, and Manipulation, Including Both Hand and Machine Tools. A Book of Practical Instruction in All Classes of Machine Shop Practice. By William H. Van Dervoort, M. E. New York: Norman W. Henley & Co. Cloth; pp. 552; tables, and 673 figures in the text. $4.

THE COPPER HANDBOOK.—A Manual of the Copper Industry of the World. Vol. III. For the Year 1903. By Horace J. Stevens. Houghton, Mich.: Horace J. Stevens. Cloth; 6 x 9 ins.; pp. 600. $5.

TREATISE ON HYDRAULICS.—By Mansfield Merriman, Professor of Civil Engineering in Lehigh University. Eighth Editon, Rewritten and Enlarged. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 ins.; pp. 593; 55 tables; 199 figures in the text. $5.